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GEOTECHNICAL INVESTIGATION
CITY OF CORCORAN
ARSENIC REMOVAL WATER
TREATMENT PLANT
CORCORAN, CALIFORNIA

BSK JOB G05-064-11B

Submitted to:

QUAD KNOPF

May 16, 2005

BSK

BSK

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May 16, 2005

BSK JOB G05-064-11B

Quad Knopf
5001 California Avenue, Suite 230
Bakersfield, California 93309

Attn: Mr. Terry Schroepfer

Subject: Geotechnical Investigation
City of Corcoran
Arsenic Removal Water Treatment Plant
Corcoran, California

Gentlemen:

In accordance with our Proposal GB05-047, dated March 6, 2005, we have performed a Geotechnical Investigation for the City of Corcoran, Arsenic Removal Water Treatment Plant in Corcoran, California.

We appreciate the opportunity to be of service. If you have questions regarding the information contained in this report, please call.

Respectfully submitted,

BSK Associates

On-Man Lau, PE, GE
Geotechnical Engineer

REGISTERED PROFESSIONAL ENGINEER
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No. 2644
Exp. 12/31/05
GEOTECHNICAL
STATE OF CALIFORNIA

OML/wp

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TABLE OF CONTENTS

GEOTECHNICAL INVESTIGATION
CITY OF CORCORAN
ARSENIC REMOVAL WATER TREATMENT PLANT
CORCORAN, CALIFORNIA

1. INTRODUCTION

This report presents the results of a Geotechnical Investigation for the City of Corcoran, Arsenic Removal Water Treatment Plant in Corcoran, California.

The purpose of our investigation was to evaluate the proposed project with respect to known geotechnical features at the site, and to provide geotechnical recommendations concerning project development.

The scope of services generally outlined in our Proposal GB05-047, dated March 6, 2005 included: review of an existing report, field exploration, laboratory testing and presentation of the project data.

2. CHANGED CONDITIONS AND LIMITATIONS

The information submitted in this report is based upon the data obtained from exploratory borings performed at the locations shown on the Boring Location Map, Figures A2-1 and A2-2, Appendix A, the results of laboratory testing performed on selected soil samples as presented in Appendix B, and other salient data as described herein.

Samples taken and tested, and observations made, are assumed to be representative of the site. This report does not reflect variations that may occur between test hole locations. Care should be taken in extrapolating subsurface conditions between test hole locations.

BSK has prepared this report for the exclusive use of Quad Knopf and their Project Design Team. BSK has endeavored to prepare this report in accordance with generally accepted practices using the degree of care ordinarily exercised under similar circumstances, by reputable geotechnical engineers and geologists practicing at this time or in a similar locality. No warranties, either expressed or implied, are made as to the professional advice provided under the terms of the agreement and included in this report.

3. PROJECT DESCRIPTION

The proposed Arsenic Removal Water Treatment Plant will consist the following:

- One 500,000 gallon with 75-feet diameter and one future Sand Sediment/Blend Tanks will be supported with a concrete or steel ring with gravel in-fill.
- The Arsenic Filter Vessel (one currently planned and one future) will be supported on shallow mat foundation.
- The 300,000 gallon Backwash Recovery Tank (two proposed) will be supported with a concrete or steel ring with gravel in-fill.
- One 500,000 gallon and one future million gallon Finish Water Tanks will be supported on a concrete ring wall or steel ring wall foundation with gravel in-fill.
- 3,000± square foot metal building (Water Plant Office) will be supported on shallow foundation.
- A Lift Station will be founded 15 feet below grade.
- A Pump Station will be founded 10 feet below grade.
- Water Line Pipe crossing along Pickerell Avenue at Highway 43.

4. SITE DESCRIPTION

The relatively flat site is located at the existing City of Corcoran Water Treatment Facility in Corcoran, California. The existing Facility, buildings and structures are located at the northwest portion of the site. An existing building is located at the southwestern portion of the site. Currently, a majority of the site is a vacant field. The surrounding features are presented in Figure A2-1, in Appendix A.

The pipe jack location for the water line crossing is located along Pickerell Avenue which crosses Highway 43. The Sweet Canal is located east of the water line alignment and the canal was full of water at the time of our investigation on March 18, 2005. The pipe jack location is located south of the water treatment plant.

A Vicinity Map is included as Figure A1, in Appendix A.

5. FIELD DATA

A total of nine (9) borings were advanced during the field investigation conducted on March 18, 2005. A truck-mounted drill rig equipped with an 8-inch diameter hollow-stem auger was used. Maximum explored depth was approximately 31.5 feet. Borings B-7 and B-8 were performed at the pipe jack location and the remainder of the borings were performed at the Arsenic Removal Water Treatment Plant.

Four (4) cone penetration tests (CPT) were performed on March 18, 2005 extending to a maximum depth of about 50 feet below the existing ground surface. The CPT tests were performed by Kehoe Testing & Engineering using an integrated electronic cone system manufactured by Vertec. The CPT was pushed using a 30-ton CPT Rig.

The Logs of Borings (Figures A4 through A12) from this investigation are presented in Appendix A. CPT results from this investigation are presented in Appendix C. Locations of the borings and CPT are presented on the Boring Location Map, Water Treatment Plant Site, Figure A2-1.

6. LABORATORY DATA

Selected soil samples from this investigation were tested to evaluate in-place moisture and density, consolidation characteristics, direct shear, expansion index, and corrosion potential. Laboratory test results and description of testing procedures are presented in Appendix B.

7. SUBSURFACE SOIL/GROUNDWATER CONDITIONS

7.1 Arsenic Removal Water Treatment Plant Site

Based on the current soil boring and CPT data, generally, at the eastern two-thirds of the Site, the upper 10 feet of the on-site soils consist of clayey silt and silty clay. At Boring B-3, fill consisting of clayey silt with asphalt concrete and concrete debris was encountered at the upper 3 feet. Below this layer, alternating layers of sand, silty sand, sandy silt and clayey silt were encountered to the maximum explored depth of 50.5 feet.

At the western one-third of the site, the upper 5 feet of the on-site soils consist of silty sand underlain with silty sand and clayey silt to maximum explored depth of 26.5 feet. At Boring B-5, fill consisting of silty sand with asphalt concrete and glass debris was encountered at the upper 5 feet. At the pump/lift station area, sand was encountered between depths of 5 and 20 feet below ground surface.

The consolidation tests indicate that the near surface soils have a low potential for hydrocompaction. However, the soil samples when saturated expanded approximately 2 to 4 percent.

The upper five feet of the on-site soils are considered to have a medium expansion potential with an Expansion Index range from 52 to 64.

Groundwater was encountered in Boring B-6 at approximately 20 feet below ground surface on March 18, 2005.

The soil profile described above is generalized; therefore, the reader is advised to consult the Logs of Borings (Borings B-1 through B-6 and Boring B-9) in Appendix A, for soil conditions at specific locations and depths. Care should be exercised in interpolating or extrapolating subsurface conditions beyond the test hole locations/depths.

7.2 At the Pipe Jack Location

Based on the current soil boring data, the upper 15 feet of the on-site soils consist of clayey silt and silty clay underlain with silty sand and sand to the maximum explored depth of 26.5 feet.

Groundwater was not encountered.

The soil profile described above is generalized; therefore, the reader is advised to consult the Logs of Borings (Borings B-7 and B-8) in Appendix A, for soil conditions at specific locations and depths. Care should be exercised in interpolating or extrapolating subsurface conditions beyond the test hole locations/depths.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1 General

Based on data collected during this investigation, it is our conclusion that the project, as described, is geotechnically feasible provided the recommendations contained in this report are implemented during planning, design and construction.

Findings and recommendations presented herein are subject to review by BSK during grading and foundation construction when subsurface conditions become more fully exposed.

The primary geotechnical constraints identified at the site are the fill soils with debris and potentially expansive soils. A potential for differential movement would therefore exist unless the soils are prepared to provide uniform support for the buildings and structures as described herein.

8.2 Grading and Earthwork

8.2.1 Site Preparation

Prior to commencement of site grading, the area should be stripped of surface vegetation and miscellaneous debris. Strippings should not be used as engineered fill. Excavations resulting from the removal of buried obstructions and abandoned lines should be backfilled with properly compacted granular fill as described herein.

8.2.2 Site Excavation

a. ***Below Grade Structures (Pump/Lift Stations and other below grade Structures)*** - Compaction beneath the mat foundation for the below grade structures greater than 5 feet below existing grade is not necessary unless the soil at the foundation bearing level is disturbed during excavation. If the soil is disturbed or unstable in the opinion of BSK, then the soil should be compacted in accordance with the recommendations presented in Section 8.2.3.

b. ***Arsenic Filter Vessel and Water Plant Office***

At the structure/building areas, the sites should be overexcavated five feet below existing grade. The overexcavation should extend a minimum of 5 feet outside of exterior footing lines. After excavation, the exposed soil should be scarified 8 inches, brought to optimum moisture content and compacted to 90 percent of the maximum dry density as determined by ASTM Test Method D1557. The excavated soil should be reviewed by BSK prior to reuse as backfill material. The backfill material should be moisture conditioned and compacted in accordance with the recommendations in Section 8.2.3. The upper two feet of the finished pads should consist of select, non-expansive fill material. Select, non expansive material from on-site or import sources which meet the requirement in Table 8.2.1 should be used.

c. ***Backwash Recovery, Sand Sediment/Blend and Finish Water Tanks***

The tank sites should be overexcavated five feet below existing grade. The overexcavation should extend a minimum of 5 feet outside of exterior footing lines. After excavation, the exposed soil should be scarified 8 inches, brought to optimum moisture content and compacted to 90 percent of the maximum dry density as determined by ASTM Test Method D1557 and backfilled in accordance with our previous recommendations.

8.2.3 Fill Material and Compaction

Generally, the near surface on-site soils are considered to have moderate expansion potential. In some areas, fill soil with debris was encountered; therefore, sorting may be required prior to use as engineering fill material

Imported soils are anticipated and should be reviewed by BSK prior to use. At least four working days notice should be allowed for review. Import material

should consist of non-corrosive, non-hazardous, non-expansive, inorganic granular soils conforming to the recommendations presented in Table 8.2.1.

TABLE 8.2.1 IMPORTED FILL RECOMMENDATIONS	
Maximum Expansion Index	20
Maximum Particle Size (inches)	3
Maximum Water Soluble Sulfate (SO_4) in Soil (percent by weight)	0.10
Range of Percent Passing #200 Screen	15-50
Minimum Sand Equivalent for Pipe Bedding Envelope	30

Clayey on-site soils should be placed in maximum 8-inch thick loose lifts, uniformly brought to between optimum and two percent above optimum moisture content, and uniformly compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM Test Method D1557. Non expansive on-site soils or imported soils should be placed in maximum 8-inch thick loose lifts, uniformly brought to optimum moisture content, and uniformly compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM Test Method D1557.

Fill should be tested for conformance to recommended compaction and moisture content criteria. Field moisture and density testing should conform to ASTM Test Methods D1556, D2922 and/or D3017. At a minimum, tests should be performed after the bottom of the overexcavation has been processed (Section 8.2.2), at every lift, and/or every 500 cubic yards of fill placed. Actual test intervals may vary as field conditions dictate. Fill that does not conform to the criteria specified in this section should be removed or otherwise reworked to conform to BSK's recommendations. Continuous observation by BSK's staff

should be maintained during structural fill placement and compaction. Periodic compaction tests should be performed by BSK to supplement field observations.

8.2.4 Utility Trench Backfill

Underground utility lines should be installed according to the manufacturer's recommendations. However, where manufacturers' recommendations are not available, underground utilities should be installed as described herein.

Small-diameter utility lines should have no less than 12 inches of cover. A minimum of 6 inches of compacted sand bedding (Sand Equivalent greater than 30), and a pipe envelope extending 6 inches above the pipe should be provided. The remaining backfill material may consist of on-site native and stockpile soils. Utility trench backfill should be placed and compacted to a minimum of 90 percent of maximum dry density as determined by ASTM Test Method D1557. Where space limitations exist, a hand compactor may be used.

8.3 Foundation Recommendations

8.4.1 General

Provided the recommendations contained in this report are implemented during design and construction, it is our opinion that the proposed structures can be supported on shallow spread or mat foundations.

A Structural Engineer should evaluate configurations and reinforcement requirements for structural loadings, shrinkage and temperature stresses. The potential for favorable foundation performance can be further enhanced by maintaining uniform subsurface moisture conditions during and after construction.

8.4.2 Foundations

Continuous spread footings for the proposed project should be a minimum of 12 inches wide, and embedded a minimum of 18 inches below the lowest

adjacent soil subgrade. Isolated spread footings should be a minimum of 24 inches wide and embedded a minimum of 24 inches below the lowest adjacent soil subgrade. Mat foundations should be embedded a minimum of 12 inches below lowest adjacent soil subgrade.

Footing excavations should be neat and trim, devoid of slough. The bottom of the footing excavation should be in a firm, moist, stable condition prior to the placement of steel and/or concrete.

Water Plant Office - Provided that our grading recommendations are implemented, we recommend an allowable soil bearing pressure of 2,000 pounds per square foot. This value may be increased by 1/3 for transient loads, such as wind or seismic forces.

Total and differential immediate settlement under static loads of square footings supported on properly compacted fill and sized for the recommended bearing pressure are expected to be 3/4 and ½ inch, respectively. Differential settlement of continuous footings, expressed in terms of angular distortion, is estimated to be on the order of 1/500.

Arsenic Filter Vessel - Provided that our grading recommendations are implemented, we recommend an allowable soil bearing pressure of 2,000 pounds per square foot. This value may be increased by 1/3 for transient loads, such as wind or seismic forces. The modulus of subgrade reaction of 130 pci may be used for mat or slab design purposes.

Total and differential immediate settlement under static loads of mat foundation supported on properly compacted fill and sized for the recommended bearing pressure are expected to be 3/4 and ½ inch, respectively.

Water Tanks - The concrete or steel ring foundation should be embedded at least 1.5 (one and one-half) feet below rough tank pad grade.

We recommend an allowable bearing pressure of 2,000 pounds per square foot for the concrete ring foundation. This value may be increased by 1/3 for transient loads, such as wind or seismic forces.

For a 75 feet diameter tank with a load of 2,000 pounds per square foot, we estimated settlement at the center of the tank is approximately 2 inches and at the edge of the tank is approximately 1 inch.

For a 55 feet diameter tank with a load of 2,000 pounds per square foot, we estimated settlement at the center of the tank is approximately 1-1/2 inches and at the edge of the tank is approximately 3/4 inch.

8.4 Lateral Pressures and Frictional Resistance

The walls for below grade structures should be designed to resist the lateral earth pressures presented in Table 8.4.1. The values are based on level, drained backfill conditions with on-site material consisting of a mixture of fine grained and granular soils.

TABLE 8.4.1
LATERAL EARTH PRESSURES - BACKFILL

Pressure Type	Earth Pressure lb./ft^2/ft
Active (drained, compacted)	40
At-Rest (drained, compacted)	53
Passive	305

For a wall considered subject to lateral yielding, with level drained granular backfill, the seismic increment of lateral earth pressure is given by the Mononobe-Okabe equation in which the lateral force (P_E) is given by the relationship:

$P_E =$ 3/8 x bulk density of soil x H^2 x horizontal ground acceleration in g's

Where H = height of wall and the horizontal ground acceleration is taken as 0.85 x the peak value. A horizontal ground acceleration of 0.22g is recommended.

Accordingly, for a yielding wall, the seismic increment of the active lateral force can be taken as $9H^2$ (pounds per linear foot of wall length) acting at 0.6H above the wall base. A yielding wall in this instance is considered as a wall that is free to rotate at the top at least 0.1 percent of the wall height.

For a non-yielding wall with level drained granular backfill, the following equation is used to evaluate the seismic increment of lateral pressure:

$P_E =$ bulk density of soil x H^2 x horizontal ground acceleration where the terms are described in the previous section.

Accordingly, for a non-yielding wall, the seismic increment of the earth pressure can be taken at $23H^2$ (pounds per linear foot of wall length) acting at 0.5H above the wall base.

A soil coefficient of friction of 0.34 may be used for structures.

The recommended Lateral Earth Pressures presented above are ultimate values. Safety factors consistent with design considerations should be applied. A minimum Factor of Safety of 1.5 against lateral sliding is recommended if the sliding is resisted only by frictional resistance.

When combined passive and frictional resistance is used, we recommend a minimum Safety Factor of 2.0. For lateral stability against seismic loading, we recommend a minimum Safety Factor of 1.1.

Vertical soil loads for compacted soils should be calculated on the basis of a bulk density of 125 pounds per square foot.

8.5 Seismic Coefficient

The site does not lie near an active fault and does not lie within Seismic Zone 4; therefore, the near-source factor and seismic source type do not apply. Based on the results of our subsurface exploration, the site soils may be characterized as stiff soil profile, which corresponds to a Soil Profile Type Sd in accordance with the 1997 Uniform Building Code.

For seismic design of the structures, in accordance with the 1997 Uniform Building Code, the following parameters can be used:

TABLE 8.5.1
SEISMIC COEFFICIENTS

Seismic Item	Value	UBC Reference
Coefficient Ca	0.36	Table 16Q
Coefficient Cv	0.54	Table 16R

8.6 Trench Excavation Stability

Based on our field work, it is our opinion that the on-site soils should be considered a Type "B" Soil (*California Code of Regulations, Title 8 Sections 1504, 1539-1543*). Construction slopes should be constructed in accordance with the current Division of Occupation Safety and Health (OSHA) guidelines. For Type "B" Soil, the OSHA standards generally call for a 1 horizontal to 1 vertical slope ratio for cuts to a maximum depth of 20 feet. The actual inclination of the construction slopes should be based on the actual field conditions exposed.

Job site safety, including trench excavation stability, is the responsibility of the General Contractor.

8.7 Temporary Construction Slopes

Maximum temporary construction slope height is anticipated to be on the order 15 feet. The excavation should either be shored or sloped back at a 1:1 (horizontal:vertical) slope ratio or flatter. The actual slope inclinations will be based on conditions encountered in the field during excavation. Water should not be allowed to flow over construction slopes and into excavations. Heavy equipment should not be operated or stored closer than 5 feet from the top of the slope.

8.8 Soil-Borne Salt Protection

Surficial soil sample obtained from the site was tested to provide a preliminary screening of the potential for concrete deterioration or steel corrosion due to attack by soil-borne soluble salts. The test results indicated that the upper 5 feet of the on-site soils have pH of 8, chloride concentration of 25 ppm, and soluble sulfate was non detected.

A sulfate content of this magnitude would have a negligible effect on normally formulated concrete. Based on the limited testing performed, the use of a special concrete formulation is not indicated.

Based on our experience in this area, generally, the soil has a low resistivity which is considered corrosive to buried metal conduit. Therefore, buried steel pipes and ferrous metal objects should be provided with protective coatings.

8.9 Construction Observations

We recommend that BSK be retained to provide testing and observation services during site preparation and grading and during foundation construction phases of the project. This would include continuous observations and testing of earthwork, and review of structure and foundation excavations immediately prior to concrete and steel placement.

Geotechnical observations and testing during construction are an important extension of the geotechnical investigation. Field review during site excavation allows for evaluation of the exposed soil conditions and confirmation of revision of the assumptions and extrapolations made in formulating our conclusions and recommendations. If an

engineering firm other than BSK is retained to provide geotechnical engineering services during construction, the company should notify the owner, designers, the appropriate governmental agencies and this office that it has assumed responsibility for all phases (design and construction) of the project within the purview of the geotechnical engineer.

BSK Associates

APPENDIX A

FIELD INVESTIGATION

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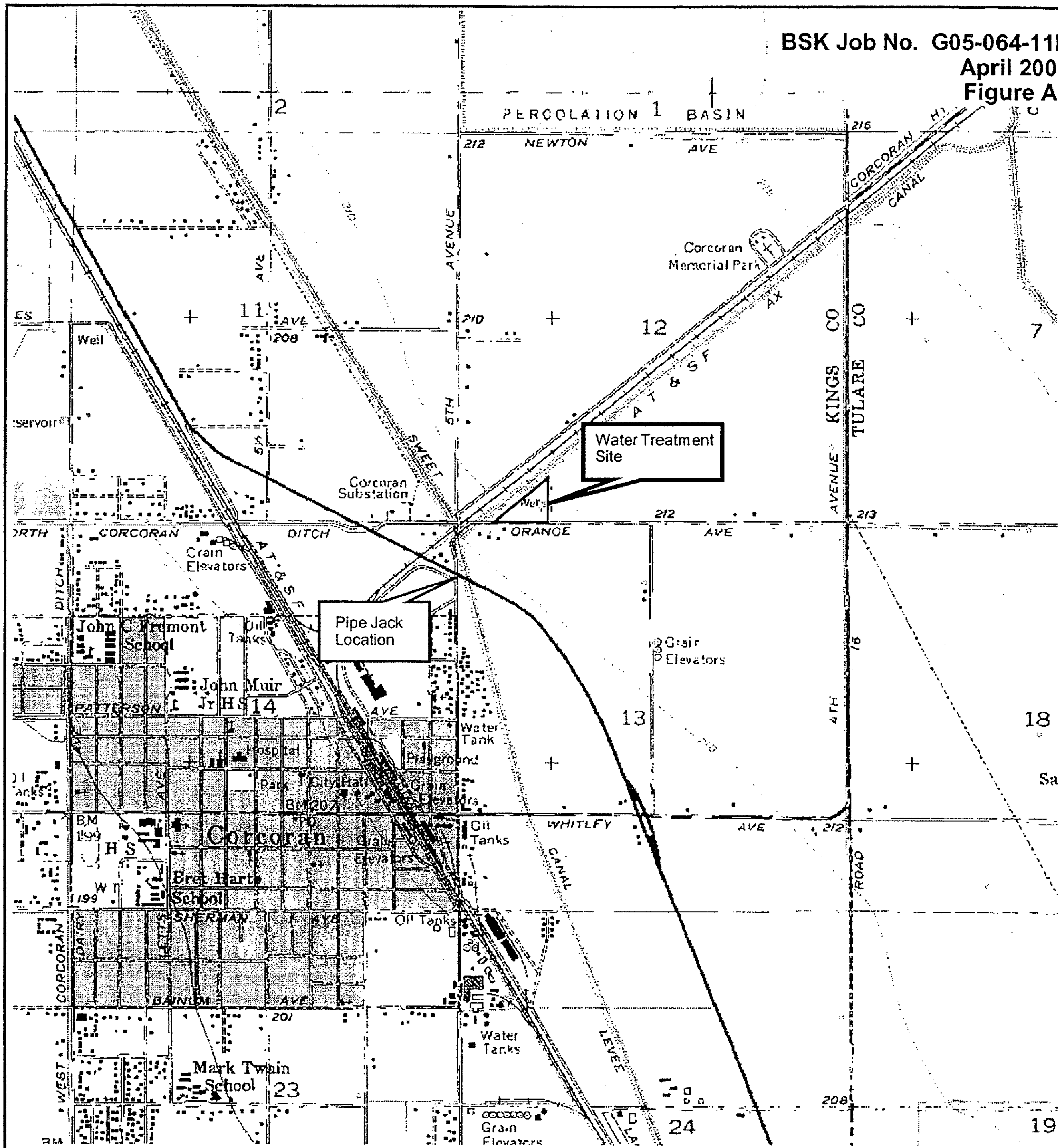

Map Reference:. 3-D TopoQuads Copyright 1999 Delorme Yarmouth, ME 04096 Source Data: USGS Scale: 1:25000Detail: 13-1 Datum: WGS84

N

Approximate Scale

0 2000 Ft

1 inch = 2000 Feet

VICINITY MAP

CITY OF CORCORAN
ARSENIC REMOVAL WATER TREATMENT PLANT
CORCORAN, CALIFORNIA

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FIELD INVESTIGATION

A.1 Test Hole Drilling

The field investigations were conducted on March 18, 2005. Nine (9) borings were drilled with a truck-mounted drill rig using an 8-inch diameter, hollow-stem auger and hand auger equipment. The approximate test hole locations are indicated on the Boring Location Map, Figures A2-1 and A2-2.

The borings were located in the field by pacing from existing landmarks. Hence, boring location accuracy can be implied only to the degree that this method warrants.

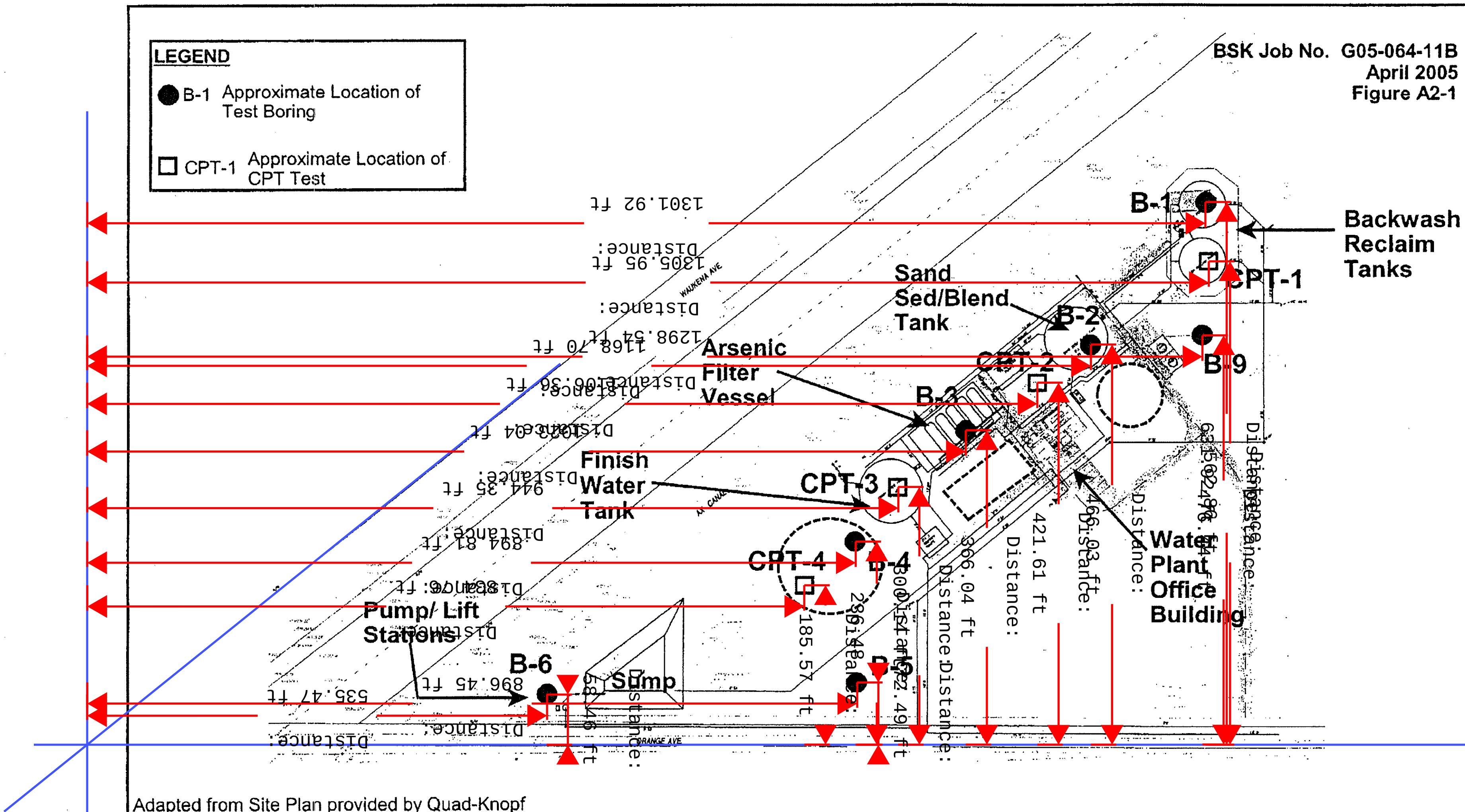
Relatively intact and bulk samples were obtained at various depths during test boring drilling. Standard Penetration Testing was performed. The intact samples were generally obtained by driving a 2.4-inch inside diameter sampler into soils. The sampler was driven with a 140-pound hammer falling from a height of 30 inches. Field blow counts required to drive the sampler are recorded on the Logs of Borings. Bulk samples were also obtained during test boring drilling.

The borings were loosely backfilled with drilled soil cuttings.

A.2 Logs of Test Holes

A continuous log of soils encountered in the test holes was recorded at the time of the field investigations by our Engineers. The soils were classified based on field observations and laboratory test results. The classifications are in general accordance with the Unified Soil Classification System (see Soil Log Legend, Figure A3). Locations and depths of sampling, soil classifications, and in-place soil dry densities and moisture contents are indicated on the Logs of Borings shown on Figures A4 through A12.

Stratification lines on the logs represent approximate boundaries between predominant soil types. Layers of differing material may be contained within the strata. Transitions between strata may be either gradual or distinct.



BORING LOCATION MAP
WATER TREATMENT PLANT SITE

CITY OF CORCORAN
ARSENIC REMOVAL WATER TREATMENT PLANT
CORCORAN, CALIFORNIA

Approximate Scale
0 170 Feet N

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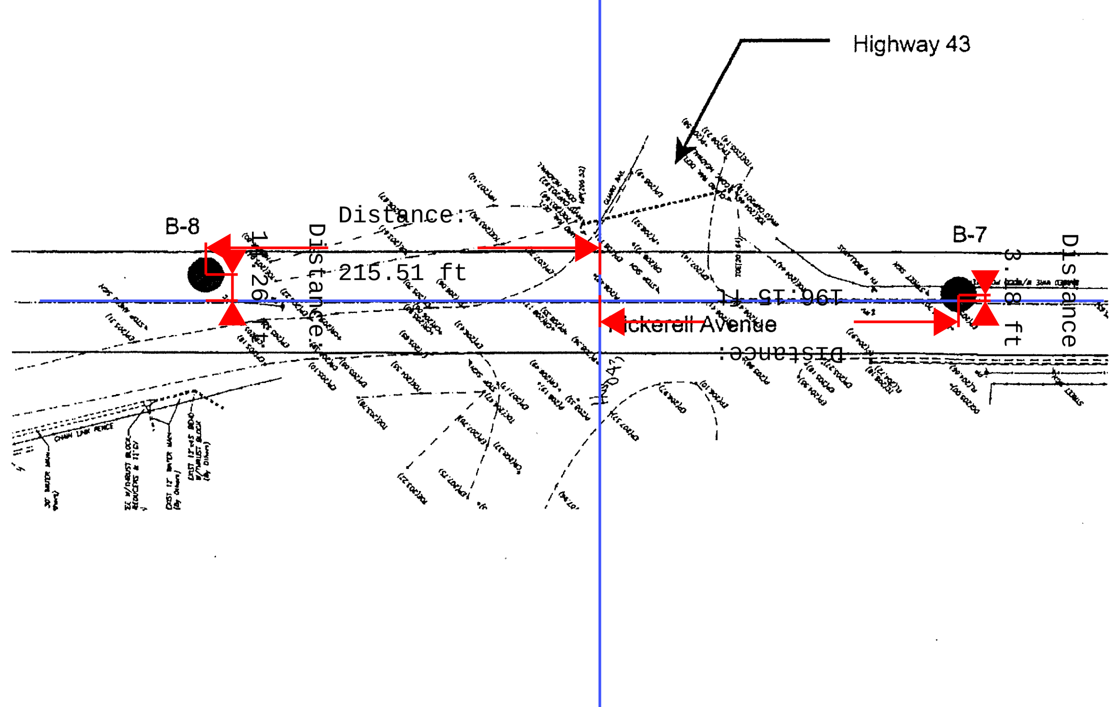
April 2005
Figure A2-2

LEGEND

● B-1 Approximate Location of Test Boring



Adapted from Site Plan provided by Quad-Knopf

BORING LOCATION MAP
PIPE JACK LOCATION

CITY OF CORCORAN
ARSENIC REMOVAL WATER TREATMENT PLANT
CORCORAN, CALIFORNIA

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BSK JOB NO: G05-064-11B
FIGURE NO: A3

SOIL LOG LEGEND

UNIFIED SOIL CLASSIFICATION SYSTEM

(Standard ASTM Test Method D2487 For Classification Of Soils For Engineering Purposes)

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS More than 50% retained on the No. 200 sieve	GRAVEL AND GRAVELLY SOILS More than 50% of coarse fraction retained on No.4 sieve	CLEAN GRAVELS (Less than 5% fines)		GW	Well-graded gravel, gravel-sand mixtures, little or no fines
				GP	Poorly-graded gravel, gravel-sand mixtures, little or no fines
		GRAVELS WITH FINES (More than 12% fines)		GM	Silty gravel, gravel-sand-silt mixtures
				GC	Clayey gravel, gravel-sand-clay mixtures
	SAND AND SANDY SOILS 50% or more of coarse fraction passes No.4 sieve	CLEAN SANDS (Less than 5% fines)		SW	Well-graded sand, gravelly sand, little or no fines
				SP	Poorly graded sand, gravelly sand, little or no fines
		SANDS WITH FINES (More than 12% fines)		SM	Silty sand, sand-silt mixtures
				SC	Clayey sand, sand-clay mixtures
FINE GRAINED SOILS 50% or more passes the No. 200 sieve	SILTS AND CLAYS Liquid Limit Less Than 50	INORGANIC		ML	Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or clayey silt with slight plasticity
				CL	Lean clay-low to medium plasticity, gravelly clay, sandy clay, silty clay
		ORGANIC		OL	Organic silt and organic silty clay of low plasticity
	SILTS AND CLAYS Liquid Limit 50 or More	INORGANIC		MH	Elastic silt, micaceous or diatomaceous fine sand or silty soil
				CH	Fat clay-high plasticity
		ORGANIC		OH	Organic clay-medium to high plasticity; organic silt
HIGHLY ORGANIC SOILS				PT	Peat, humus, swamp soil with high organic content

NOTE: Dual symbols are used to indicate borderline soil classifications

SAMPLER SYMBOLS

Auger Cuttings	No Recovery
Disturbed Sample	Shelby Tube
Rock Core	Hand Auger/Sampler
California Sampler	Standard Penetration Test
	Cone Penetration Test

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LOG OF BORING B-1

BSK JOB NO: G05-064-11B
FIGURE NO: A4
SHEET 1 of 1

DATE: 3/18/05
LOGGED BY: On Man Lau
WATER LEVEL: No Groundwater Encountered
GROUND ELEVATION:
EQUIPMENT: CME 75, 8" HSA

DEPTH, FT.	DRY DENSITY, PCF	MOISTURE, %	OVM READING PPM	BLOWS/FOOT	TYPE OF SAMPLER	U.S.C.S.	SYMBOLS	DESCRIPTION	REMARKS
						CL		**SILTY CLAY:** dark brown; slightly moist.	
	91	19		30					
5	108	9		55		ML-CL		**CLAYEY SILT/SILTY CLAY:** olive brown; moist.	
10	105	5		50		SP		**SAND:** light brown; fine grained; slightly moist.	
15				35		CL		**SANDY CLAY:** olive brown; moist.	
20				45		SM		**SILTY SAND:** olive brown; fine grained; moist.	**Boring Terminated at 21.5 Feet**

The described soil conditions may not be representative of those at different locations and times.

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LOG OF BORING B-2

BSK JOB NO: G05-064-11B
FIGURE NO: A5
SHEET 1 of 1

DATE: 3/18/05
LOGGED BY: On Man Lau
WATER LEVEL: No Groundwater Encountered
GROUND ELEVATION:
EQUIPMENT: CME 75, 8" HSA

DEPTH, FT.	DRY DENSITY, PCF	MOISTURE, %	OVM READING PPM	BLOWS/FOOT	TYPE OF SAMPLER	U.S.C.S.	SYMBOLS	DESCRIPTION	REMARKS
0						ML-CL		**CLAYEY SILT/SILTY CLAY: dark brown; slightly moist.**	
5	107	10		63		ML		**CLAYEY SILT: olive gray; moist.**	
10	101	3		45		SP-SM		**SAND/SILTY SAND: light gray; fine grained; slightly moist.**	
15				55		ML		**SANDY SILT: olive gray; trace of clay; moist.**	
20				36					**Boring Terminated at 21.5 Feet**

The described soil conditions may not be representative of those at different locations and times.

BSK

LOG OF BORING B-3

BSK JOB NO: G05-064-11B
FIGURE NO: A6
SHEET 1 of 1

DATE: 3/18/05
LOGGED BY: On Man Lau
WATER LEVEL: No Groundwater Encountered
GROUND ELEVATION:
EQUIPMENT: CME 75, 8" HSA

DEPTH, FT.	DRY DENSITY, PCF	MOISTURE, %	OVM READING PPM	BLOWS/FOOT	TYPE OF SAMPLER	U.S.C.S.	SYMBOLS	DESCRIPTION	REMARKS
	89	23		55		ML		**CLAYEY SILT: brown; moist. (Encountered Fill: soil with asphalt concrete and concrete debris)**	
5	103	19		55		ML		**SANDY SILT: olive gray; trace of clay; moist. (Native)**	
						SP-SM		**SAND/SILTY SAND: brown; fine grained; slightly moist.**	
10				24		SP		**SAND: olive brown; fine grained; slightly moist.**	
15				55					
20				50		SM		**SILTY SAND: dark olive gray; fine grained; moist.**	**Boring Terminated at 21.5 Feet**

The described soil conditions may not be representative of those at different locations and times.

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LOG OF BORING B-4

BSK JOB NO: G05-064-11B
FIGURE NO: A7
SHEET 1 of 1

DATE: 3/18/05
LOGGED BY: David Smith
WATER LEVEL: No Groundwater Encountered
GROUND ELEVATION:
EQUIPMENT: CME 75, 8" HSA

DEPTH, FT.	DRY DENSITY, PCF	MOISTURE, %	OVM READING PPM	BLOWS/FOOT	TYPE OF SAMPLER	U.S.C.S.	SYMBOLS	DESCRIPTION	REMARKS
						ML		**CLAYEY SILT: dark yellowish brown; slightly moist.**	
	107	12		13		ML		**SANDY SILT: olive gray; trace of clay; moist.**	
5	105	20		35				**Layer of CLAYEY SILT/SILTY CLAY: olive brown; moist.**	
10	121	13		43		SM		**SILTY SAND: yellowish brown; fine to medium grained; moist.**	
15				21		ML		**CLAYEY SILT: olive brown; moist.**	
20				55		SP		**SAND: olive gray; fine grained; slightly moist.**	
25				46					**Boring Terminated at 26.5 Feet**

The described soil conditions may not be representative of those at different locations and times.

BSK

LOG OF BORING B-5

BSK JOB NO: G05-064-11B
FIGURE NO: A8
SHEET 1 of 1

DATE: 3/18/05
LOGGED BY: David Smith
WATER LEVEL: No Groundwater Encountered
GROUND ELEVATION:
EQUIPMENT: CME 75, 8" HSA

DEPTH, FT.	DRY DENSITY, PCF	MOISTURE, %	OVM READING PPM	BLOWS/FOOT	TYPE OF SAMPLER	U.S.C.S.	SYMBOLS	DESCRIPTION	REMARKS
						SM		**SILTY SAND: dark brown; fine grained; moist. (Encountered Fill: soil with asphalt concrete and glass debris)**	
5	**112**	**5**		**27**		**SM**		**SILTY SAND: yellowish brown; fine to medium grained; moist. (Native)**	
10	**120**	**13**		**55**					
15	**103**	**22**		**55**		**ML**		**CLAYEY SILT: olive brown; moist.**	
20				**39**					**Boring Terminated at 21.5 Feet**

The described soil conditions may not be representative of those at different locations and times.

BSK

LOG OF BORING B-6

BSK JOB NO: G05-064-11B
FIGURE NO: A9
SHEET 1 of 1

DATE: 3/18/05
LOGGED BY: David Smith
WATER LEVEL: Feet
GROUND ELEVATION:
EQUIPMENT: CME 75, 8" HSA

DEPTH, FT.	DRY DENSITY, PCF	MOISTURE, %	OVM READING PPM	BLOWS/FOOT	TYPE OF SAMPLER	U.S.C.S.	SYMBOLS	DESCRIPTION	REMARKS
						SM		**SILTY SAND: brown; fine to medium grained; moist.**	
5	98	4		47		SP		**SAND: olive gray; fine grained; slightly moist.**	
10				39					
15	97	3		50					
20				40		SM		**SILTY SAND: brown; fine to medium grained; wet.**	∇
25				30					**Boring Terminated at 26.5 Feet**

The described soil conditions may not be representative of those at different locations and times.

BSK

LOG OF BORING B-7

BSK JOB NO: G05-064-11B
FIGURE NO: A10
SHEET 1 of 1

DATE: 3/18/05
LOGGED BY: David Smith
WATER LEVEL: No Groundwater Encountered
GROUND ELEVATION:
EQUIPMENT: CME 75, 8" HSA

DEPTH, FT.	DRY DENSITY, PCF	MOISTURE, %	OVM READING PPM	BLOWS/FOOT	TYPE OF SAMPLER	U.S.C.S.	SYMBOLS	DESCRIPTION	REMARKS
0						SC		CLAYEY SAND: dark brown; moist.	
5	108	16		32		ML-CL		CLAYEY SILT/SILTY CLAY: olive brown; moist.	
10				36		ML		CLAYEY SILT: olive brown; moist. Layer of SAND: brown; fine grained; moist.	
15				38		SM		SILTY SAND: olive brown; fine grained; moist.	
20				13		SM-SC		SILTY SAND/CLAYEY SAND: olive brown; fine grained; very moist.	Boring Terminated at 21.5 Feet

The described soil conditions may not be representative of those at different locations and times.

BSK

LOG OF BORING B-8

BSK JOB NO: G05-064-11B
FIGURE NO: A11
SHEET 1 of 1

DATE: 3/18/05
LOGGED BY: David Smith
WATER LEVEL: No Groundwater Encountered
GROUND ELEVATION:
EQUIPMENT: CME 75, 8" HSA

DEPTH, FT.	DRY DENSITY, PCF	MOISTURE, %	OVM READING PPM	BLOWS/FOOT	TYPE OF SAMPLER	U.S.C.S.	SYMBOLS	DESCRIPTION	REMARKS
0						CL		SILTY CLAY: dark brown; moist.	
5				22		SC-CL		CLAYEY SAND/SANDY CLAY: olive brown; moist.	
10	111	19		40					
						ML		CLAYEY SILT: olive brown; moist.	
15				30					
						SM		SILTY SAND: olive brown; fine grained; moist.	
20				32		SP		SAND: light brown; fine grained; moist.	
25									Boring Terminated at 25 Feet

The described soil conditions may not be representative of those at different locations and times.

BSK

LOG OF BORING B-9

BSK JOB NO: G05-064-11B
FIGURE NO: A12
SHEET 1 of 1

DATE: 3/18/05
LOGGED BY: On Man Lau
WATER LEVEL: No Groundwater Encountered
GROUND ELEVATION:
EQUIPMENT: CME 75, 8" HSA

DEPTH, FT.	DRY DENSITY, PCF	MOISTURE, %	OVM READING PPM	BLOWS/FOOT	TYPE OF SAMPLER	U.S.C.S.	SYMBOLS	DESCRIPTION	REMARKS
						ML-CL		CLAYEY SILT/SILTY CLAY: dark brown; slightly moist.	
	90	17		32					
5	95	20		40				olive brown, moist.	
10						SP		SAND: light brown; fine to medium grained; slightly moist.	Boring Terminated at 11.5 Feet

The described soil conditions may not be representative of those at different locations and times.

BSK

APPENDIX B

LABORATORY TESTING PROCEDURES

BSK

LABORATORY TESTING PROCEDURES

B.1 Moisture-Density Tests

The field moisture content, as a percentage of the dry weight of the soil, was determined by weighing samples before and after oven drying. Dry densities, in pounds per cubic foot, were also determined for the undisturbed samples. Results of these determinations are shown on the Logs of Borings, Figures A4 through A12, included in Appendix A.

B.2 Direct Shear Test

Direct shear tests were performed on relatively remolded soil samples to determine strength characteristics of the soil. Test specimens were soaked with water prior to testing. Results of the shear strength test are shown on Figures B1 through B3.

B.3 Consolidation Tests

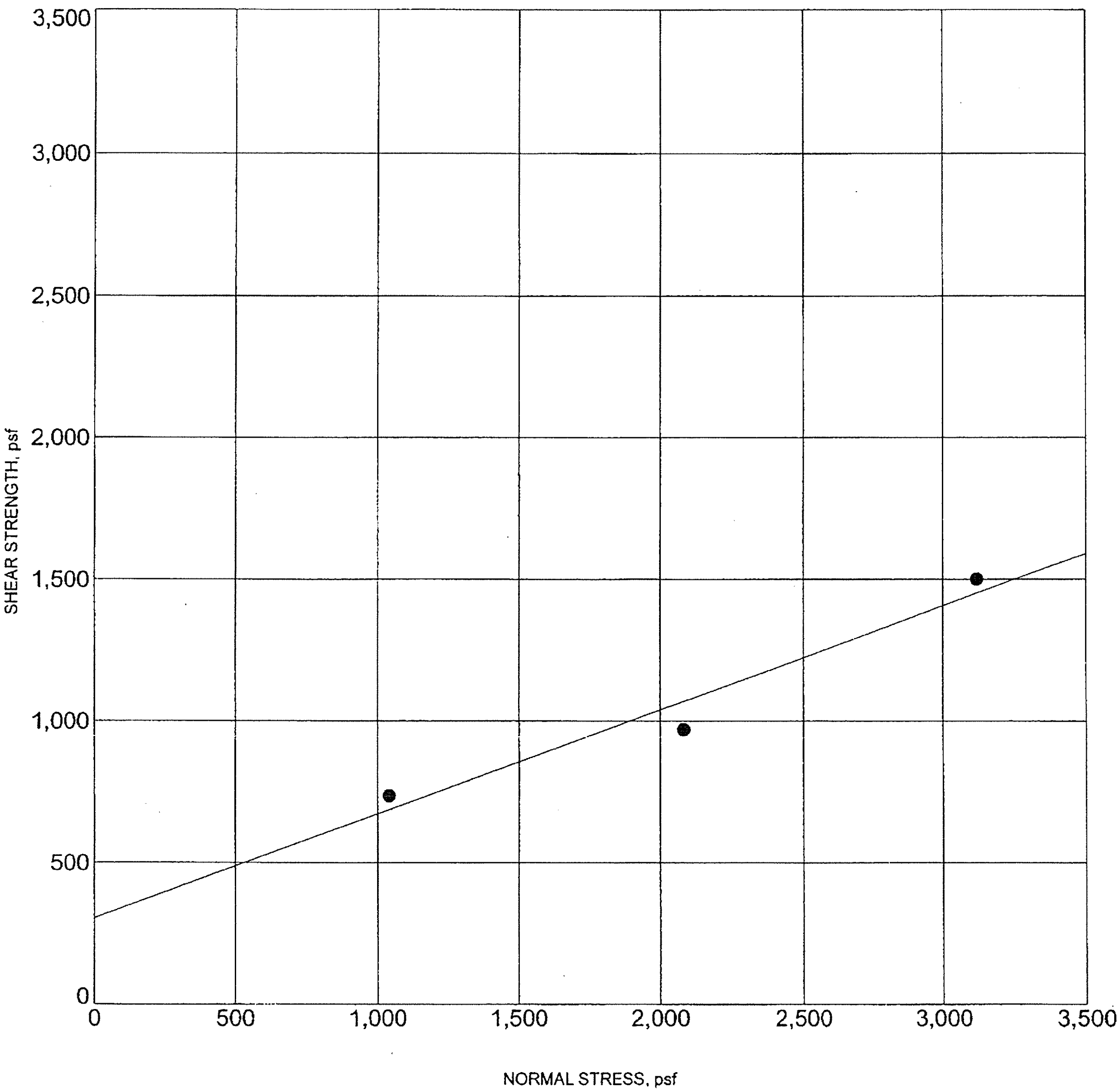
Consolidation characteristics of the site soils were determined by using intact soil samples subjected to dead weight loading increments in a consolidometer. The samples were soaked when loading reached the approximate overburden pressure. Test results are illustrated by a curve indicating the percent volume change of the soil under various loads. Results of Consolidation-Swell Tests are shown on Figures B4 through B6.

B.4 Expansion Index Test

The Expansion Potential of samples of the surficial soils was obtained in accordance with Uniform Building Code 18-2. Results are presented on Table B1.

BSK JOB: G05-064-11B
Date: 3/18/05
Figure: B1

DIRECT SHEAR DIAGRAM



Boring No.: B-1
Friction Angle: 20 degrees
Dry Density: 91 pcf

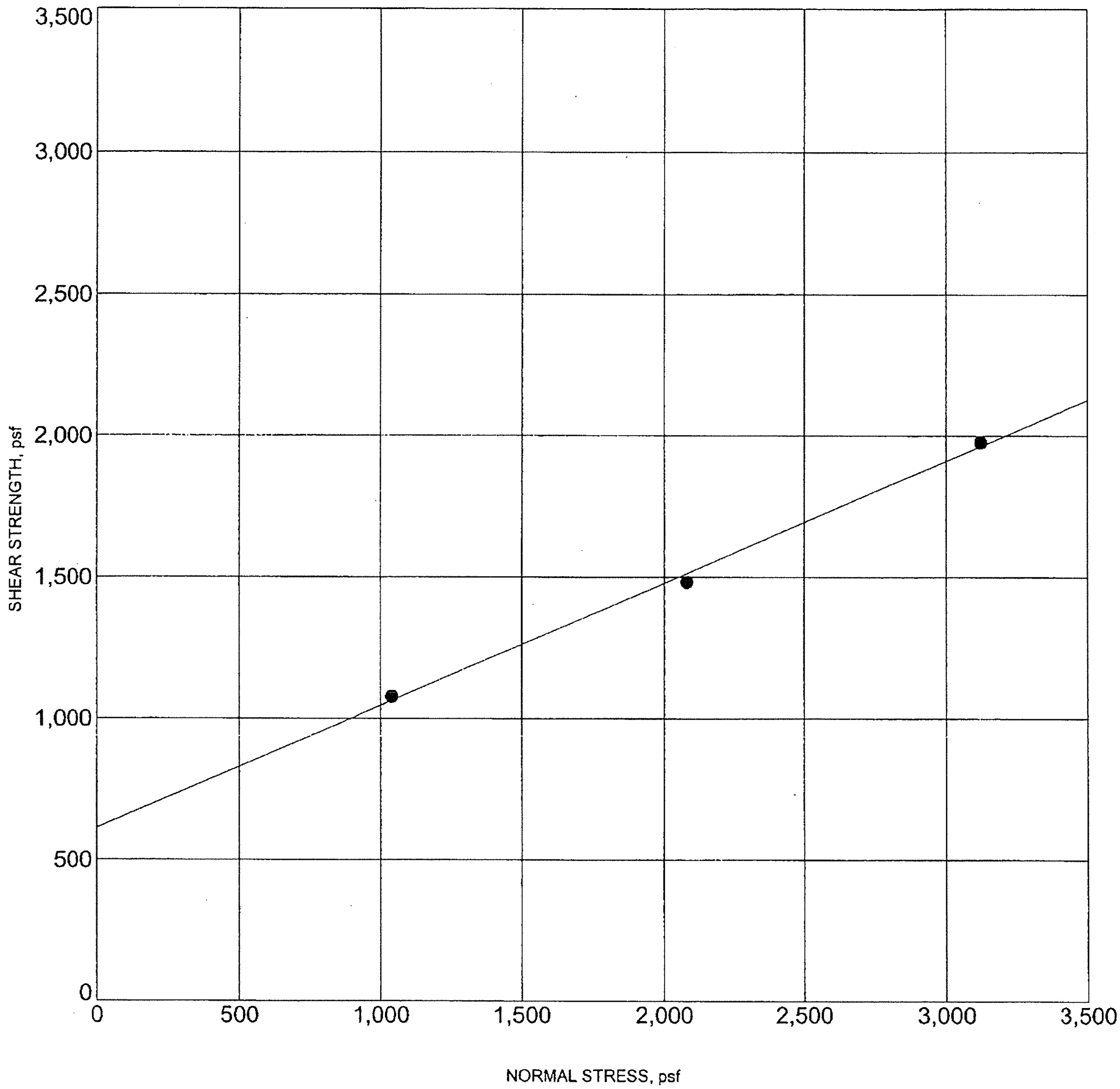
Sample Depth: 2.0 ft.
Cohesion: 303 psf
Intact

PROJECT: Arsenic Removal Water Treatment Plant
City of Corcoran

BSK

BSK JOB: G05-064-11B
Date: 3/18/05
Figure: B2

DIRECT SHEAR DIAGRAM



Boring No.: B-2

Friction Angle: 23 degrees

Dry Density: 107 pcf

Sample Depth: 5.0 ft.

Cohesion: 612 psf

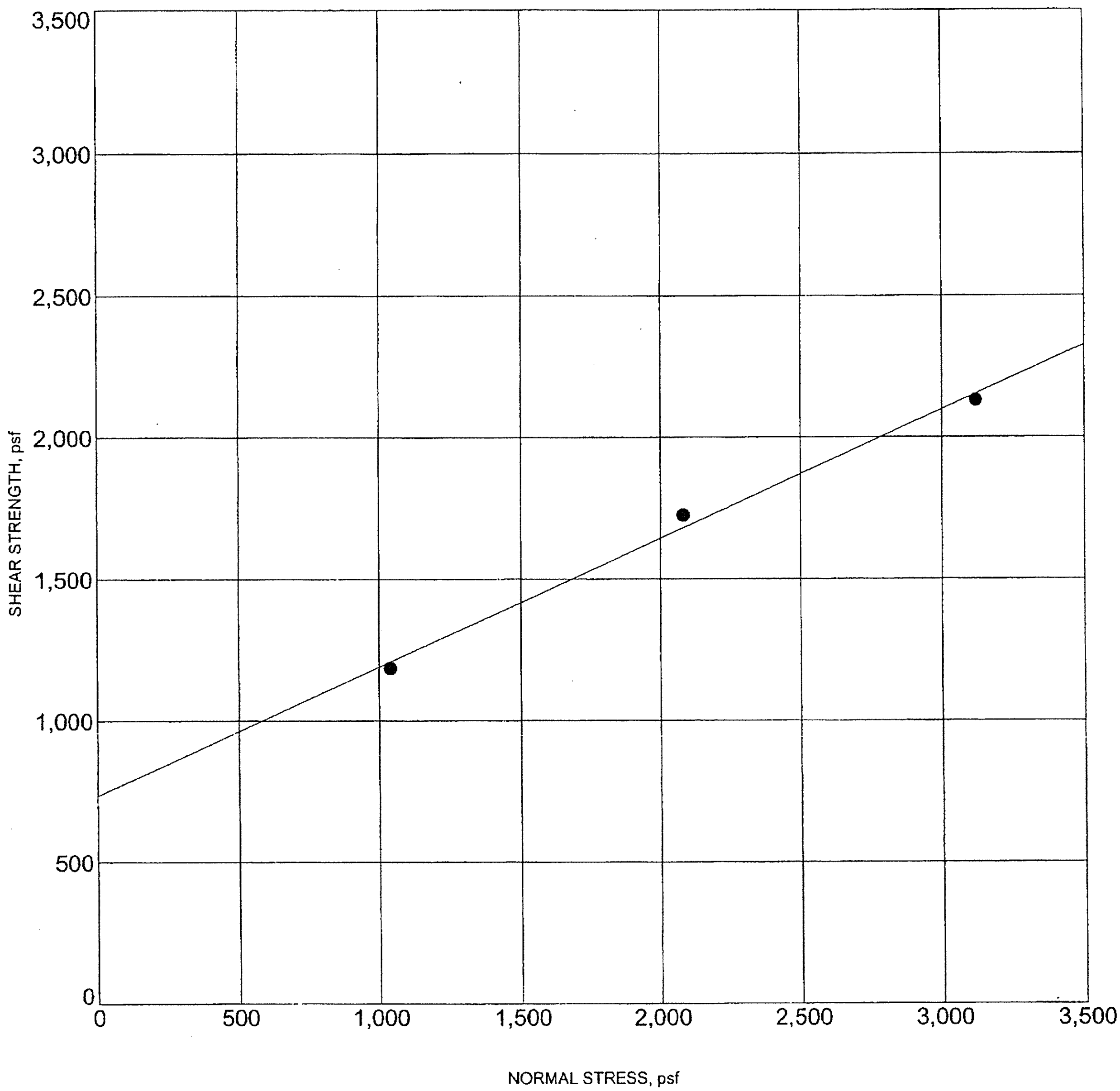
Intact

PROJECT: Arsenic Removal Water Treatment Plant
City of Corcoran

BSK

BSK JOB: G05-064-11B
Date: 3/18/05
Figure: B3

DIRECT SHEAR DIAGRAM



Boring No.: B-3

Friction Angle: 24 degrees

Dry Density: 89 pcf

Sample Depth: 2.0 ft.

Cohesion: 735 psf

Intact

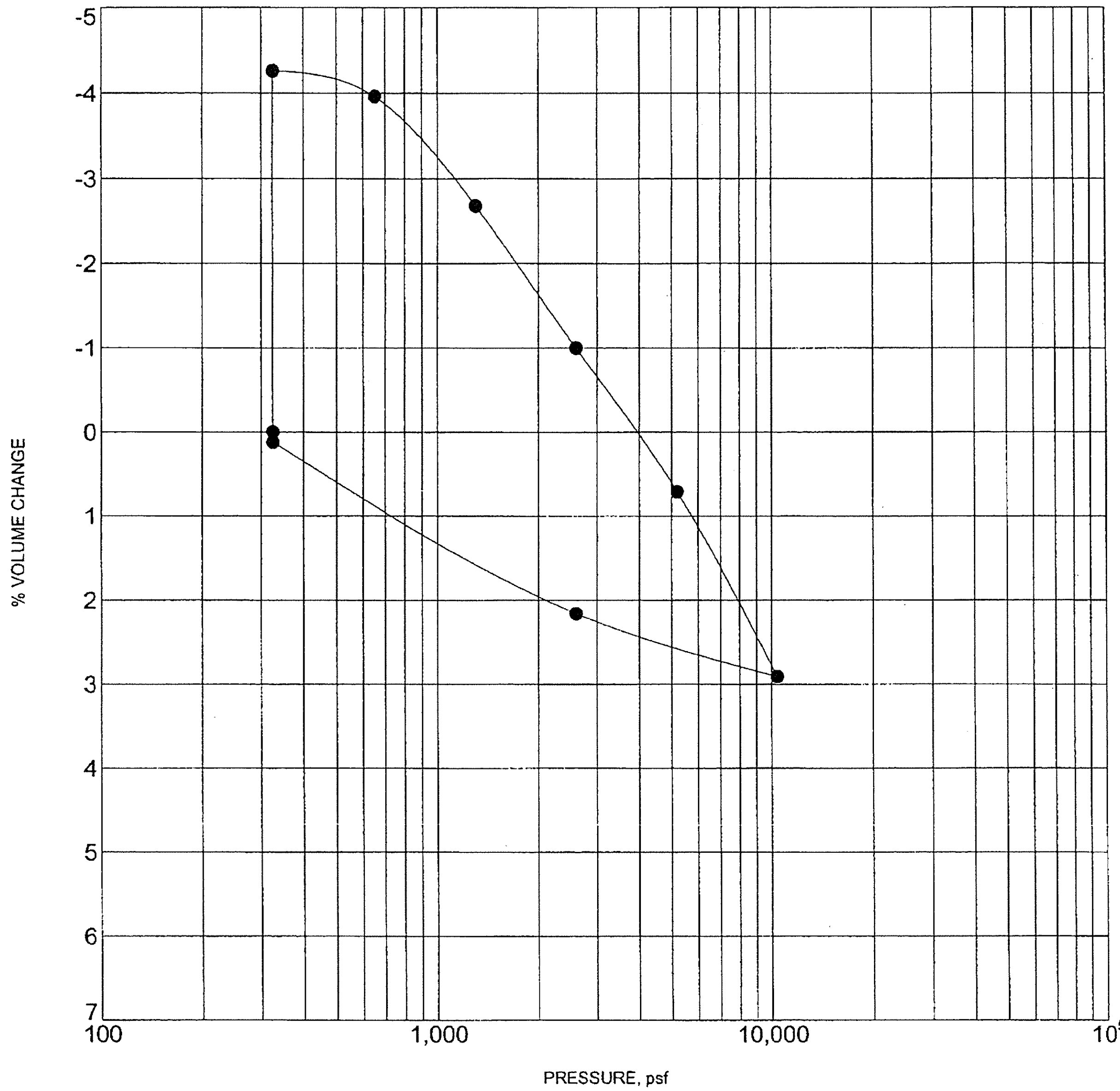
PROJECT: Arsenic Removal Water Treatment Plant
City of Corcoran

BSK

BSK JOB: G05-064-11B
Date: 3/18/05
Figure: B4

CONSOLIDATION TEST

% Volume Change vs. Pressure Curve



	Specimen Identification		Classification	Soaked psf	DD pcf	MC%
●	B-1	5.0 ft.	**CLAYEY SILT/SILTY CLAY: olive**	**325**	**108**	**9**
			brown.			

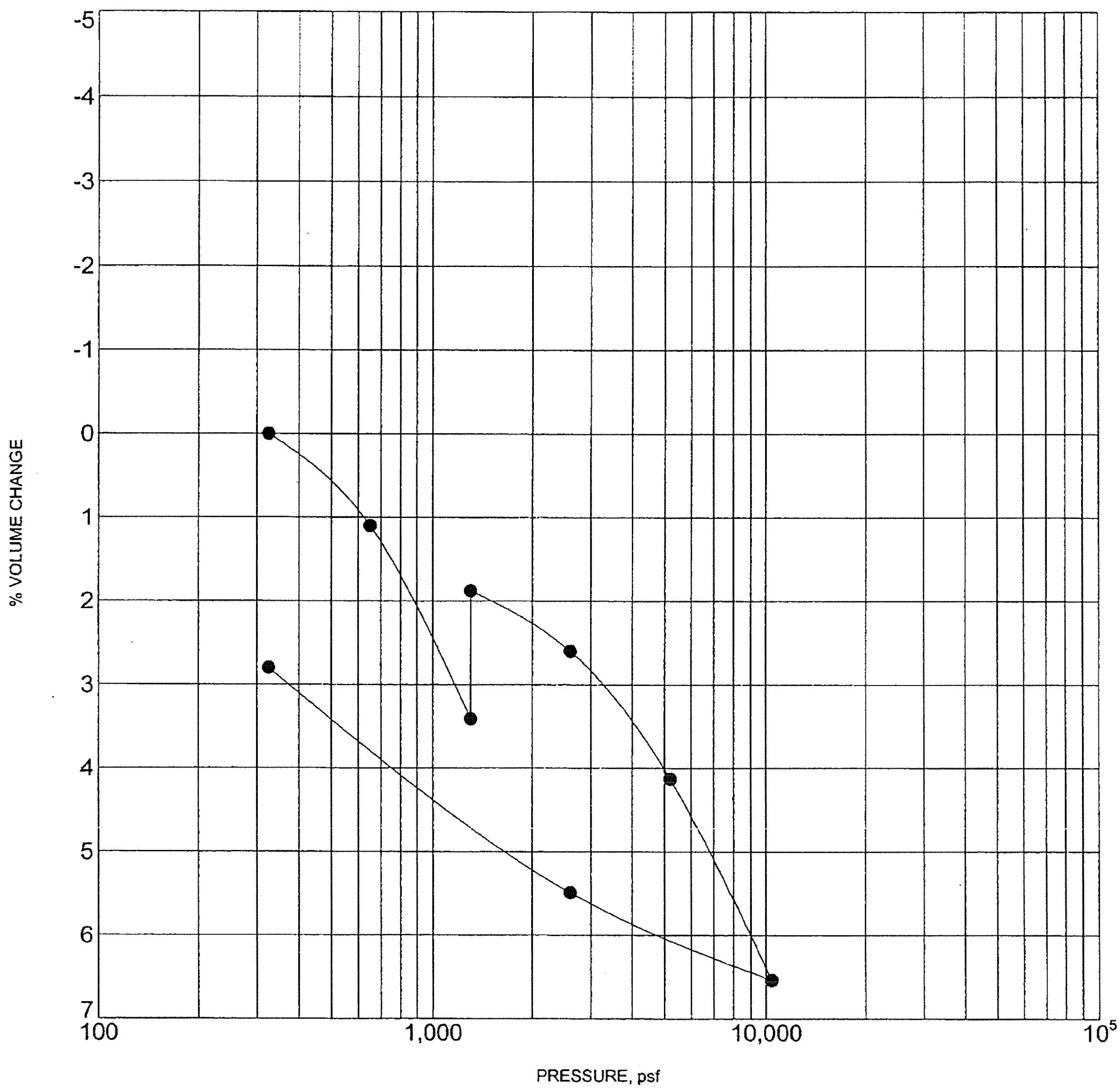
PROJECT: Arsenic Removal Water Treatment Plant
City of Corcoran

BSK

CONSOLIDATION TEST

BSK JOB: G05-064-11B
Date: 3/18/05
Figure: B5

% Volume Change vs. Pressure Curve



Specimen Identification			Classification	Soaked psf	DD pcf	MC%
●	B-4	5.0 ft.	CLAYEY SILT/SILTY CLAY: olive brown.	1300	105	20

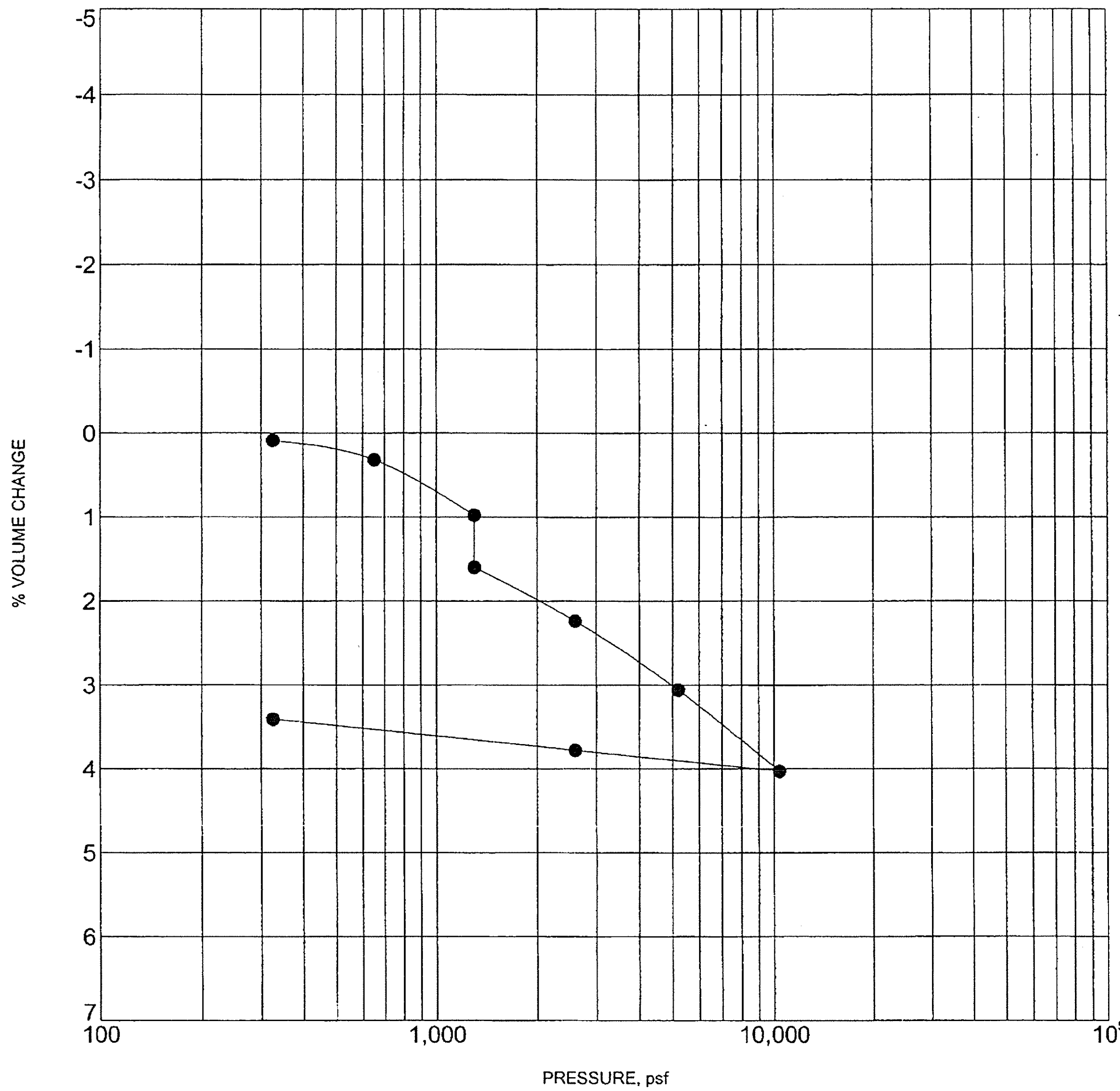
PROJECT: Arsenic Removal Water Treatment Plant
City of Corcoran

BSK

CONSOLIDATION TEST

BSK JOB: G05-064-11B
Date: 3/18/05
Figure: B6

% Volume Change vs. Pressure Curve



	Specimen Identification		Classification	Soaked psf	DD pcf	MC%
●	B-4	10.0 ft.	**SILTY SAND/CLAYEY SAND:**	**1300**	**121**	**13**
			yellowish brown; fine to medium			
			grained.			

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City of Corcoran

BSK

Table B.1 Expansion Test Results (Uniform Building Code Table 18-2)			
Sample Designation	**Expansion Index**	**Expansion Potential**	**Moisture Content (percent)***
Boring B-1 at 0 to 5 feet	52	medium	26
Boring B-3 at 0 to 5 feet	64	medium	28
* The final moisture content of sample after expansion.			

APPENDIX C

CONE PENETRATION TEST DATA

BSK

PRESENTATION

OF

CONE PENETRATION TEST DATA

Project:

City of Corcoran Arsenic Removal
Corcoran, CA
March 18, 2005

Prepared for:

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BSK & Associates
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Office (661) 327-0671 / Fax (661) 324-4218

Prepared by:

KTE

KEHOE TESTING & ENGINEERING
15571 Industry Lane
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Office (714) 901-7270 / Fax (714) 901-7289

TABLE OF CONTENTS

PRESENTATION

OF

CONE PENETRATION TEST DATA

1. INTRODUCTION

This report presents the results of a Cone Penetration Test (CPT) program carried out for the City of Corcoran Arsenic Removal project located in Corcoran, California. The work was performed by Kehoe Testing & Engineering (KTE) on March 18, 2005. The scope of work was performed as directed by BSK & Associates personnel.

2. SUMMARY OF FIELD WORK

The fieldwork consisted of performing CPT soundings at four locations to determine the soil lithology. The groundwater measurements were taken in the open CPT hole approximately 10 minutes after completion of CPT. The following **TABLE 2.1** summarizes the CPT soundings performed:

LOCATION	DEPTH OF CPT (ft)	COMMENTS/NOTES:
CPT-1	50	Hole open to 50 ft (dry)
CPT-2	50	Hole open to 50 ft (dry)
CPT-3	50	Hole open to 50 ft (dry)
CPT-4	50	Hole open to 50 ft (dry)

TABLE 2.1 - Summary of CPT Soundings

3. FIELD EQUIPMENT & PROCEDURES

The CPT soundings were carried out by **KTE** using an integrated electronic cone system manufactured by Vertek. The CPT soundings were performed in accordance with ASTM standards (D5778). The cone penetrometers were pushed using a 30-ton CPT rig. The cone used during the program was a 15 cm^2 cone and recorded the following parameters at approximately 2.5 cm depth intervals:

- Cone Resistance (qc)
- Sleeve Friction (fs)
- Dynamic Pore Pressure (u)
- Inclination
- Penetration Speed
- Pore Pressure Dissipation (at selected depths)

The above parameters were recorded and viewed in real time using a portable computer and stored on a diskette for future analysis and reference. A complete set of baseline readings was taken prior to each sounding to determine temperature shifts and any zero load offsets. Monitoring base line readings ensures that the cone electronics are operating properly.

4. CONE PENETRATION TEST DATA & INTERPRETATION

The Cone Penetration Test data is presented in graphical form in the attached Appendix. Penetration depths are referenced to ground surface. The soil classification on the CPT plots is derived from the CPT Classification Chart (Robertson, 1986) and presents major soil lithologic changes. The stratigraphic interpretation is based on relationships between cone resistance (qc), sleeve friction (fs), and penetration pore pressure (u). The friction ratio (Rf), which is sleeve friction divided by cone resistance, is a calculated parameter that is used to infer soil behavior type. Generally, cohesive soils (clays) have high friction ratios, low cone resistance and generate excess pore water pressures. Cohesionless soils (sands) have lower friction ratios, high cone bearing and generate little (or negative) excess pore water pressures.

Output from the interpretation program CPTINT provides averaged CPT data over one-foot intervals. The CPTINT output includes Soil Classification Zones, SPT N Values and Undrained Shear Strength (Su). A summary of the equations used for the tabulated parameters is provided in the CPTINT Correlation Table in the Appendix.

The interpretation of soils encountered on this project was carried out using correlations developed by Robertson et al, 1986. It should be noted that it is not always possible to clearly identify a soil type based on qc, fs and u. In these situations, experience, judgment and an assessment of the pore pressure data should be used to infer the soil behavior type.

If you have any questions regarding this information, please do not hesitate to call our office at (714) 901-7270.

Sincerely,

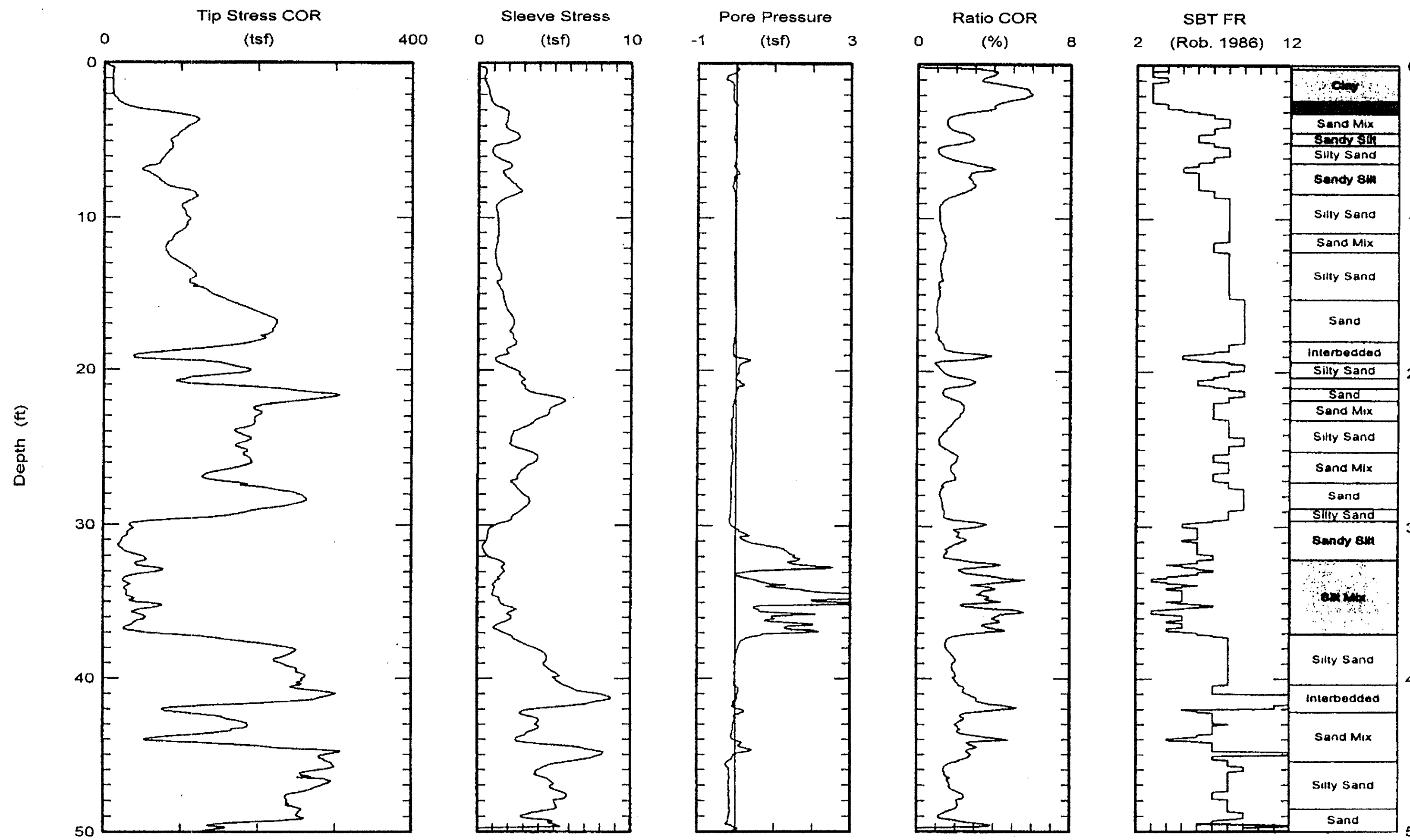
KEHOE TESTING & ENGINEERING

Steven P. Kehoe, P.E.
President

03/21/05-BS

APPENDIX

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 skehoe@msn.com	CPT Data 30 ton rig	Date: 18/Mar/2005 Test ID: CPT-1 Project: Corcoran
	Client: BSK & Associates Job Site: City of Corcoran Arsenic Removal	

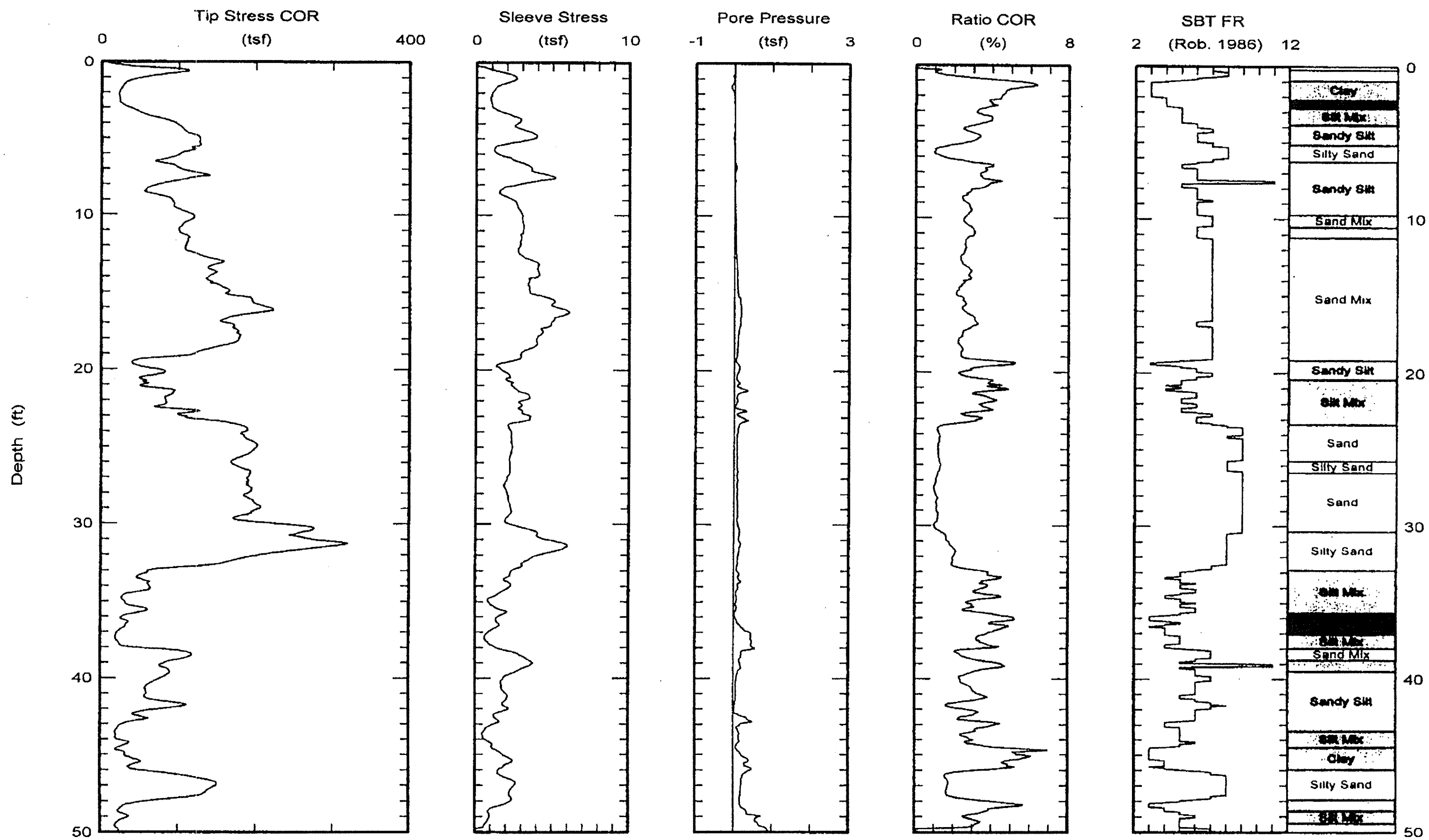


Maximum depth: 50.05 (ft)

Page 1 of 2

Test ID: CPT-1
File: Z18M0501C.ecp

Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 skehoe@msn.com	CPT Data 30 ton rig	Date: 18/Mar/2005 Test ID: CPT-2 Project: Corcoran
	Client: BSK & Associates Job Site: City of Corcoran Arsenic Removal	

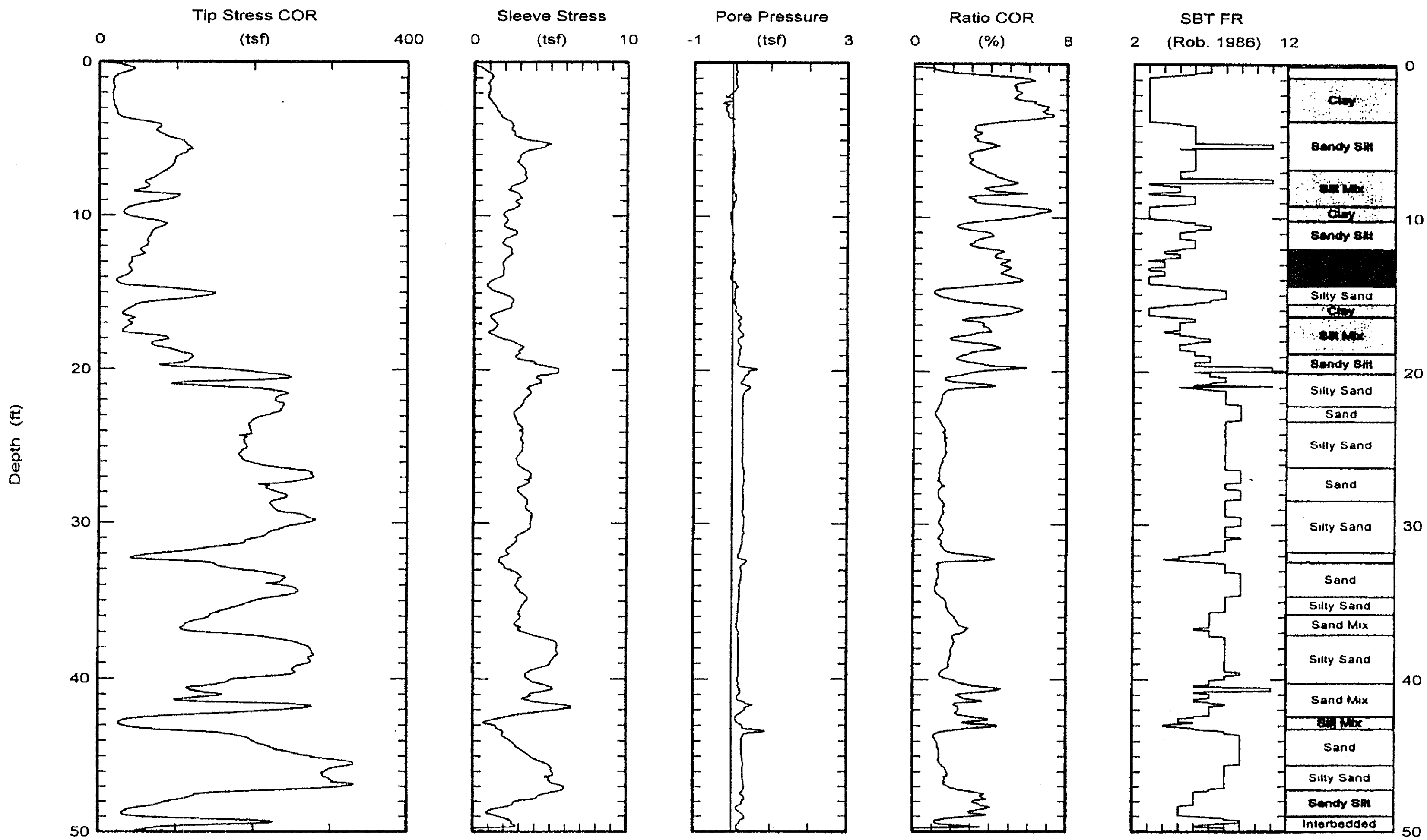


Maximum depth: 50.05 (ft)

Page 1 of 2

Test ID. CPT-2
File: Z18M0502C.ecp

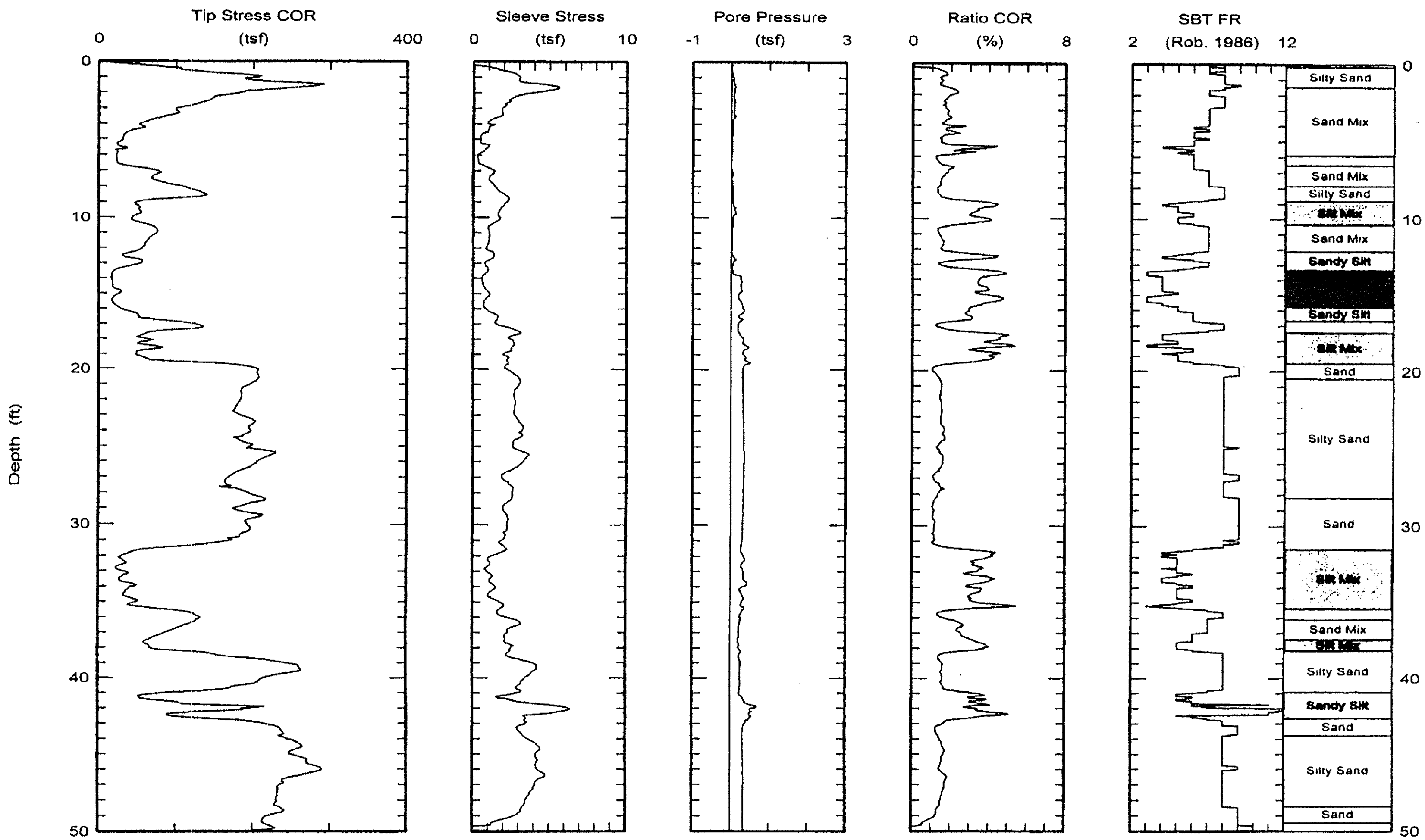
KTE Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 skehoe@msn.com	CPT Data 30 ton rig	Date: 18/Mar/2005 Test ID: CPT-3 Project: Corcoran
	Client: BSK & Associates Job Site: City of Corcoran Arsenic Removal	



Maximum depth: 50.07 (ft)
Page 1 of 2

Test ID: CPT-3
File: Z18M0503C.ecp

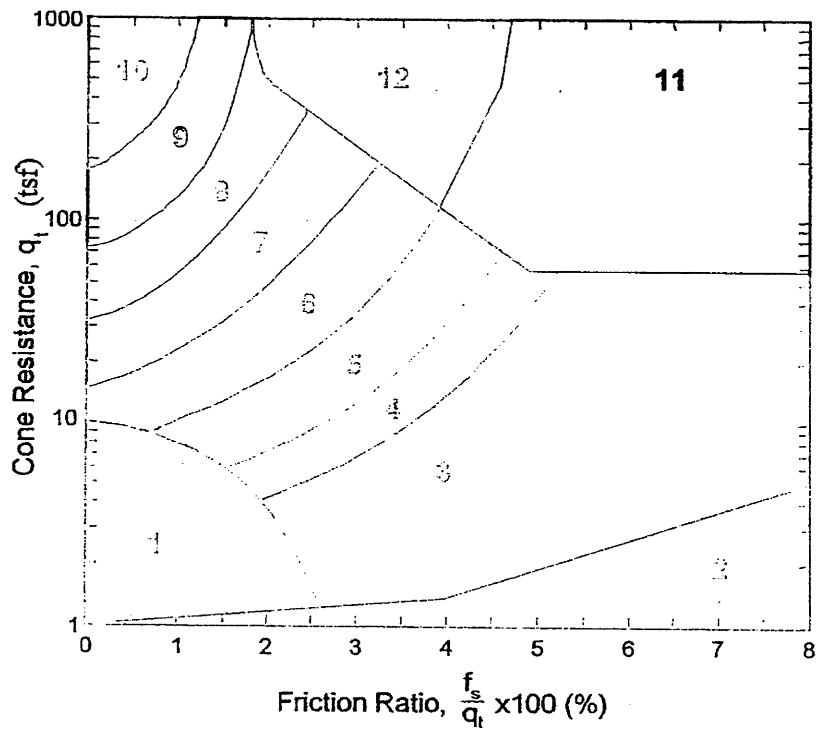
Kehoe Testing & Engineering Office: (714) 901-7270 Fax: (714) 901-7289 skehoe@msn.com	CPT Data 30 ton rig	Date: 18/Mar/2005 Test ID: CPT-4 Project: Corcoran
	Client: BSK & Associates Job Site: City of Corcoran Arsenic Removal	



Maximum depth: 50.03 (ft)
Page 1 of 2

Test ID. CPT-4
File: Z18M0504C ecp

CPT Soil Behavior Type Legend
(Robertson et al. 1986)



Zone	Soil Behavior Type
1	Sensitive, Fine Grained
2	Organic Material
3	Clay
4	Silty Clay to Clay
5	Clayey Silt to Silty Clay (Silt Mix)
6	Sandy Silt to Clayey Silt
7	Silty Sand to Sandy Silt (Sand Mix)
8	Sand to Silty Sand
9	Sand
10	Gravelly Sand to Sand
11	Very Stiff Fine Grained*
12	Sand to Clayey Sand*

*Overconsolidated or cemented

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Depth (feet)	Qc(avg) (TSF)	Fs(avg) (TSF)	Rf (%)	Rf Zone (zone #)	Spt N (blow/ft)	Spt N1 (blow/ft)	Su (TSF)
0.500	10.318	0.365	3.554	3	10	15	0.683
1.500	11.558	0.568	4.931	3	11	17	0.762
2.500	23.879	1.038	4.348	4	15	23	1.581
3.500	105.864	1.884	1.779	7	34	51	UNDF
4.500	97.954	2.342	2.390	7	31	47	UNDF
5.500	85.779	1.220	1.422	7	27	41	UNDF
6.500	65.164	1.799	2.761	6	25	38	UNDF
7.500	72.479	2.071	2.858	6	28	42	UNDF
8.500	113.554	2.242	1.974	7	36	54	UNDF
9.500	104.464	1.224	1.172	8	25	38	UNDF
10.500	106.393	1.301	1.223	8	25	35	UNDF
11.500	86.421	1.241	1.437	7	28	37	UNDF
12.500	86.569	1.140	1.317	8	21	26	UNDF
13.500	112.371	1.377	1.226	8	27	31	UNDF
14.500	122.593	1.435	1.171	8	29	32	UNDF
15.500	163.907	1.736	1.059	9	31	32	UNDF
16.500	211.600	2.192	1.036	9	41	40	UNDF
17.500	216.192	2.226	1.030	9	41	39	UNDF
18.500	145.829	2.192	1.503	8	35	32	UNDF
19.500	115.979	1.619	1.396	8	28	24	UNDF
20.500	132.836	2.852	2.147	7	42	35	UNDF
21.500	255.162	4.126	1.617	8	61	49	UNDF
22.500	209.236	4.925	2.354	7	67	52	UNDF
23.500	189.321	3.359	1.774	8	45	34	UNDF
24.500	180.273	2.235	1.240	8	43	31	UNDF
25.500	186.229	3.643	1.956	7	59	42	UNDF
26.500	154.286	2.879	1.866	7	49	34	UNDF
27.500	194.700	2.560	1.315	8	47	31	UNDF
28.500	248.714	3.249	1.306	9	48	31	UNDF
29.500	126.750	2.196	1.733	7	40	25	UNDF
30.500	31.836	0.749	2.351	6	12	7	UNDF
31.500	25.929	0.444	1.697	6	10	6	UNDF
32.500	55.640	1.487	2.658	6	21	12	UNDF
33.500	35.079	1.306	3.714	5	17	10	2.207
34.500	31.521	1.184	3.693	5	15	8	1.996
35.500	54.321	2.052	3.759	5	26	14	3.493
36.500	39.893	1.581	3.935	5	19	10	2.529
37.500	167.793	2.749	1.638	8	40	21	UNDF
38.500	236.336	4.369	1.849	8	57	29	UNDF
39.500	250.387	4.848	1.936	8	60	30	UNDF
40.500	262.350	6.085	2.319	7	84	42	UNDF
41.499	210.707	7.197	3.416	12	101	51	UNDF
42.499	138.221	3.456	2.500	7	44	22	UNDF
43.499	139.167	3.363	2.417	7	44	22	UNDF
44.499	196.115	5.615	2.863	7	63	32	UNDF
45.499	289.820	5.975	2.062	8	69	35	UNDF
46.499	274.586	4.329	1.577	8	66	33	UNDF
47.499	253.379	5.373	2.121	8	61	31	UNDF
48.499	246.738	4.492	1.820	8	59	30	UNDF
49.499	183.771	3.151	1.715	8	44	22	UNDF
50.499	98.900	0.000	0.000	9	UNDF	UNDF	UNDF

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Depth (feet)	Qc(avg) (TSF)	Fs(avg) (TSF)	Rf (%)	Rf Zone (zone #)	Spt N (blow/ft)	Spt N1 (blow/ft)	Su (TSF)
0.500	71.591	1.319	1.843	7	23	35	UNDF
1.500	33.015	1.753	5.310	3	32	48	2.195
2.500	25.138	0.978	3.892	4	16	24	1.666
3.500	63.380	2.226	3.512	5	30	45	4.211
4.500	110.436	3.278	2.968	6	42	63	UNDF
5.500	121.507	1.848	1.521	8	29	44	UNDF
6.500	88.921	2.724	3.062	6	34	51	UNDF
7.500	110.487	4.109	3.719	6	42	63	UNDF
8.500	68.346	1.841	2.693	6	26	39	UNDF
9.500	99.233	2.749	2.770	6	38	57	UNDF
10.500	110.757	3.057	2.760	6	42	58	UNDF
11.500	108.536	2.946	2.715	6	42	54	UNDF
12.500	123.620	3.025	2.446	7	39	47	UNDF
13.500	145.987	4.067	2.786	7	47	54	UNDF
14.500	150.529	3.472	2.306	7	48	52	UNDF
15.500	189.960	4.732	2.491	7	61	63	UNDF
16.500	185.293	5.501	2.969	7	59	58	UNDF
17.500	174.464	4.389	2.515	7	56	53	UNDF
18.500	153.607	3.607	2.348	7	49	44	UNDF
19.500	63.514	2.154	3.390	5	30	26	4.157
20.500	65.347	2.103	3.216	6	25	21	UNDF
21.500	80.986	3.052	3.767	5	39	31	5.313
22.500	92.857	2.986	3.214	6	36	28	UNDF
23.500	157.307	2.695	1.713	8	38	29	UNDF
24.500	191.550	2.344	1.223	8	46	33	UNDF
25.500	187.679	2.289	1.219	8	45	32	UNDF
26.500	183.567	2.203	1.200	8	44	30	UNDF
27.500	191.636	1.971	1.028	9	37	25	UNDF
28.500	195.473	2.175	1.112	9	37	24	UNDF
29.500	188.971	2.127	1.126	9	36	23	UNDF
30.500	259.021	3.520	1.359	9	50	31	UNDF
31.500	276.147	5.381	1.948	8	66	39	UNDF
32.500	149.227	3.198	2.143	7	48	28	UNDF
33.500	56.179	2.164	3.851	5	27	15	3.609
34.500	42.853	1.459	3.403	5	21	12	2.717
35.500	44.743	1.501	3.353	5	21	11	2.837
36.500	29.847	1.344	4.496	4	19	10	1.842
37.500	22.100	0.809	3.643	4	14	7	1.325
38.500	98.000	2.733	2.786	6	38	19	UNDF
39.500	84.000	2.806	3.339	6	32	16	UNDF
40.500	63.636	1.765	2.773	6	24	12	UNDF
41.499	79.353	1.997	2.516	6	30	15	UNDF
42.499	49.853	1.518	3.042	6	19	10	UNDF
43.499	21.114	0.650	3.076	5	10	5	1.229
44.499	28.600	1.201	4.197	4	18	9	1.724
45.499	41.627	2.063	4.946	3	40	20	2.592
46.499	117.085	2.039	1.741	7	37	19	UNDF
47.499	124.067	2.354	1.897	7	40	20	UNDF
48.499	32.373	1.327	4.087	4	21	11	1.964
49.499	23.943	0.528	2.192	6	9	5	UNDF
50.499	21.700	0.000	0.000	7	UNDF	UNDF	UNDF

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Depth (feet)	Qc(avg) (TSF)	Fs(avg) (TSF)	Rf (%)	Rf Zone (zone #)	Spt N (blow/ft)	Spt N1 (blow/ft)	Su (TSF)
0.500	30.200	0.651	2.154	6	12	18	UNDF
1.500	18.243	1.018	5.577	3	17	26	1.210
2.500	18.214	1.115	6.134	3	17	26	1.201
3.500	36.007	1.895	5.262	3	34	51	2.386
4.500	81.764	2.667	3.262	6	31	47	UNDF
5.500	113.100	4.048	3.579	6	43	65	UNDF
6.500	96.614	3.034	3.139	6	37	56	UNDF
7.500	71.664	3.276	4.571	5	34	51	4.747
8.500	74.171	2.706	3.648	5	36	54	4.910
9.500	46.893	2.510	5.353	3	45	67	3.087
10.500	70.786	2.151	3.040	6	27	37	UNDF
11.500	65.093	2.298	3.530	5	31	40	4.292
12.500	51.607	2.299	4.454	4	33	40	3.389
13.500	38.907	1.906	4.898	3	37	42	2.538
14.500	58.736	1.135	1.932	7	19	21	UNDF
15.500	92.920	2.383	2.564	6	36	37	UNDF
16.500	37.436	1.456	3.890	5	18	18	2.428
17.500	44.757	1.349	3.012	6	17	16	UNDF
18.500	86.013	2.847	3.309	6	33	30	UNDF
19.500	111.464	3.869	3.470	6	43	37	UNDF
20.500	188.873	4.635	2.453	7	60	50	UNDF
21.500	215.608	3.548	1.645	8	52	42	UNDF
22.500	232.333	2.927	1.260	9	45	35	UNDF
23.500	198.200	2.957	1.491	8	47	35	UNDF
24.500	190.479	3.168	1.663	8	46	33	UNDF
25.500	185.907	2.978	1.601	8	45	31	UNDF
26.500	245.743	3.359	1.367	8	59	40	UNDF
27.500	238.440	3.287	1.378	8	57	38	UNDF
28.500	231.343	3.377	1.459	8	55	35	UNDF
29.500	256.853	3.705	1.442	8	62	39	UNDF
30.500	229.807	3.338	1.452	8	55	34	UNDF
31.500	152.000	2.475	1.628	8	36	21	UNDF
32.500	106.286	1.903	1.789	7	34	20	UNDF
33.500	225.293	2.859	1.269	9	43	24	UNDF
34.500	240.173	3.220	1.341	8	58	32	UNDF
35.500	169.586	3.122	1.841	8	41	22	UNDF
36.500	120.180	2.953	2.457	7	38	20	UNDF
37.500	230.086	4.834	2.101	7	73	38	UNDF
38.500	275.553	5.337	1.937	8	66	34	UNDF
39.500	243.373	3.991	1.639	8	58	29	UNDF
40.500	142.757	4.458	3.122	6	55	28	UNDF
41.499	182.471	4.531	2.483	7	58	29	UNDF
42.499	93.820	2.447	2.607	6	36	18	UNDF
43.499	131.436	1.885	1.433	8	31	16	UNDF
44.499	230.753	3.065	1.328	8	55	28	UNDF
45.499	307.793	4.639	1.507	8	74	37	UNDF
46.499	302.257	5.131	1.697	8	72	36	UNDF
47.499	166.440	4.761	2.860	7	53	27	UNDF
48.499	49.829	1.724	3.457	5	24	12	3.123
49.499	127.707	1.882	1.473	8	31	16	UNDF
50.499	42.600	0.000	0.000	8	UNDF	UNDF	UNDF

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Depth (feet)	Qc(avg) (TSF)	Fs(avg) (TSF)	Rf (%)	Rf Zone (zone #)	Spt N (blow/ft)	Spt N1 (blow/ft)	Su (TSF)
0.500	111.108	1.642	1.477	8	27	41	UNDF
1.500	230.586	4.244	1.840	8	55	83	UNDF
2.500	140.100	2.446	1.746	7	45	68	UNDF
3.500	84.400	1.535	1.819	7	27	41	UNDF
4.500	43.840	0.842	1.919	6	17	26	UNDF
5.500	27.127	0.662	2.439	6	10	15	UNDF
6.500	35.443	0.610	1.721	6	14	21	UNDF
7.500	80.221	1.219	1.519	7	26	39	UNDF
8.500	115.679	1.949	1.684	7	37	56	UNDF
9.500	50.793	1.803	3.548	5	24	36	3.348
10.500	60.362	1.292	2.141	6	23	32	UNDF
11.500	65.286	1.006	1.540	7	21	27	UNDF
12.500	46.036	1.126	2.444	6	18	22	UNDF
13.500	25.877	0.822	3.175	5	12	14	1.671
14.500	19.938	0.718	3.588	4	13	14	1.274
15.500	21.331	0.814	3.806	4	14	15	1.362
16.500	64.062	1.402	2.186	7	20	20	UNDF
17.500	92.508	2.583	2.790	6	35	33	UNDF
18.500	62.150	2.523	4.055	5	30	27	4.072
19.500	108.167	2.200	2.032	7	35	30	UNDF
20.500	205.269	2.822	1.375	8	49	41	UNDF
21.500	186.727	2.780	1.488	8	45	36	UNDF
22.500	178.709	2.746	1.536	8	43	33	UNDF
23.500	195.867	3.067	1.566	8	47	35	UNDF
24.500	189.391	2.935	1.549	8	45	33	UNDF
25.500	213.445	3.265	1.529	8	51	36	UNDF
26.500	188.475	2.545	1.350	8	45	31	UNDF
27.500	170.036	2.391	1.406	8	41	27	UNDF
28.500	200.164	2.347	1.172	9	38	25	UNDF
29.500	194.309	2.215	1.140	9	37	23	UNDF
30.500	188.150	2.163	1.149	9	36	22	UNDF
31.500	88.986	1.894	2.127	7	28	17	UNDF
32.500	29.536	1.016	3.432	5	14	8	1.840
33.500	35.927	1.220	3.388	5	17	10	2.262
34.500	39.907	1.310	3.277	5	19	11	2.523
35.500	87.457	1.854	2.117	7	28	15	UNDF
36.500	113.107	2.720	2.403	7	36	19	UNDF
37.500	69.764	2.265	3.245	6	27	14	UNDF
38.500	155.093	2.661	1.715	8	37	19	UNDF
39.500	247.233	3.954	1.599	8	59	30	UNDF
40.500	174.593	3.114	1.783	8	42	21	UNDF
41.499	101.157	3.334	3.293	6	39	20	UNDF
42.499	146.457	4.445	3.033	6	56	28	UNDF
43.499	234.893	3.198	1.361	8	56	28	UNDF
44.499	255.813	4.190	1.637	8	61	31	UNDF
45.499	272.229	4.196	1.541	8	65	33	UNDF
46.499	258.600	4.439	1.716	8	62	31	UNDF
47.499	232.536	3.809	1.638	8	56	28	UNDF
48.499	232.753	3.235	1.389	8	56	28	UNDF
49.499	216.364	1.134	0.524	9	41	21	UNDF
50.499	168.100	0.000	0.000	9	UNDF	UNDF	UNDF

CPTCP.TBL - CPTINT Correlation and Parameters Table File
-------------with NOTES & References at end-------------

Program: CPTINT - CPT Cone Interpretation Program
Version: 5.2
Table File by: Dr. R. G. (DICK) Campanella, P.Eng.
Rev. Dated: April 3, 2002

Parameter	Methods	Refer. Number	Valid Soil Type	Valid Zone
Depth average see NOTE #1	Depth averaged over specified range (see menu)		All	All
Parameter Averaging	Averaged over range specified for depth. If no values exist, your choice is zero's or no value		All	All
Qc, Tip Stress	measured tip force/area	#6,#8	All	All
Qt corrtd for U2 see NOTE #2	$Qt = Qc + (1 - a) \times U2$ and a = tip area ratio Defaults to U2 if given or uses U1 or U3 times Const.	#6,#8	All	All
[Note: Input value from input file is used if defined, not calculated]				
Q (Qt Normalized)	$Q = \frac{Qt - sv}{sv'}$	#9 & 13	All	All
Fs	measured sleeve force/area	#6,#8	All	All
Rf Friction Ratio (if Rf>8, Rf=8)	$Rf = \frac{Fs}{Qt} \times 100\%$	#6,#8	All	All
F (Rf Normalized)	$F = \frac{Fs}{(Qt - sv)} \times 100\%$	#9 & 13	All	All
Gamma Total Unit Weight (Soil + Water) see NOTE #3	Based on Rf or Bq Classif. Zone Zone # Gamma = kN/m^3 1 Qt<4bar 15.70 1 Qt=4bar 17.30 2 Rf<5% 13.36 2 Rf=5% 11.80 2 Bq Zone 12.58 3 Qt<10bar 18.86 3 Qt=10bar 19.65 4, 5 & 6 Qt<20bar 18.86 4, 5 & 6 Qt=20bar 19.65 7 18.86 8 & 9 19.65 10 20.44 11 & 12 21.22		All	All

Parameter	Methods	Refer. Number	Valid Soil Type	Valid Zone
U Penetration Pore Pressure see NOTE #4	U1,measured on Face of tip U2,measured Behind Tip at shoulder (std location) U3,measured Behind Friction Sleeve		All	All
Water Table	Depth below ground surface to where pore pressure = 0 Make negative if water level is above ground		All	All
Uo Hydrostatic Pore Pressure see NOTE #4	Uo = water depth,Hw x unit weight water, Gamma or Uo=Hw=depth-depth to water table if depth<water table,Uo = 0		All	All
dU Excess Pore Pressure	dU = U2 - Uo Defaults to U2 if given or uses U1 or U3 x const.		All	All
DPPR (Differential Pore Pressure Ratio)	$DPPR = \frac{dU}{Qt} = \frac{U - Uo}{Qt}$ Defaults to U2 if given or uses U1 or U3 x const.	#6,#8	All	All
Bq	$Bq = \frac{dU}{Qt - sv}$	# 4 # 8 # 13	All	All
OS (Overburden Stress)	OS = sv = S (Gamma x Depth)		All	All
EOS (Effective Overburden Stress)	EOS = sv' = OS - Uo = sv - Uo		All	All
Rf Zone Soil Behavior Type see NOTE #5	Classification chart for Qc and Rf Zone # = Soil Behavior Type 1=sensitive fine grained 2=organic material 3=clay 4=silty clay 5=clayey silt 6=sandy silt 7=silty sand 8=fine sand 9=sand 10=gravelly sand 11=very stiff fine grained ¥ 12=sand to clayey sand ¥ ¥ overconsolidated or cemented	#6 #8, Fig4.3	All	1<Qt<1000bar 0<Rf<8%

Parameter	Methods	Refer. Number	Valid Soil Type	Valid Zone
Bq Zone Soil Behavior Type	Classification chart for Qc and Bq (same zone #'s as Rf above)	#8 Fig 4.3	All	0<Qt<1000bar -0.1<Bq<1.4
Spt N(60) Standard Penetration Test (Blows/foot) at 60% Energy After R&C(1983) see NOTE #6	Qt/N ratio per zone Zone # / Qt/N / Zone # / Qt/N 1 / 2 / 7 / 3 2 / 1 / 8 / 4 3 / 1 / 9 / 5 4 / 1.5 / 10 / 6 5 / 2 / 11 / 1 6 / 2.5 / 12 / 2	# 7 // # 8 Fig 4.2	All	All
Spt N1(60) Normalized for Overburden str	Spt N1(60) = Cn x Spt N(60) where Cn = (sv')^(-0.77)	# 8	All	0.5<Cn<1.5
Dr Relative Density see NOTE #7	Specific Sands: $Dr = \frac{100}{C2} * \ln\left[\frac{Qc}{C0\, sv'^{C1}}\right]$ where: All are NC & UNAGED	# 8		
Compressibility	Sand / C0 / C1 / C2			
moderate	Ticino / 17.37 / .558 / 2.58	# 1	Sand	7 to 10 0<Qt<500bar 0<sv'<5bar
high	Schmertmann / 15.32 / .520 / 2.75	# 1	Sand	
all	ALL SANDS: NC, OC, ALL TESTS $Dr = C3 + C4\log_{10}\left[\frac{\left(\frac{Qc}{C1}\right)}{\left(\frac{sv'}{C0}\right)^{C2}}\right]$ where: C0 / C1 / C2 / C3 / C4 0.100 / 0.0981 / 0.5 / -98 / 66	# 5	Sand	7 to 10 (6 possible)
Phi Friction Angle	Methods: 1) Robertson & Campanella 2) Durgunoglu & Mitchell 3) Janbu beta = +15 degree 4) Janbu beta = 0 degree 5) Janbu beta = -15 degree	 #6, #8 # 2 #6, #8 #6, #8 #6, #8	Sand	7 to 10 & 6 0<Qt<500bar 0<sv'<4bar 29<phi<49

Parameter	Methods	Refer. Number	Valid Soil Type	Valid Zone
Gmax Maximum Shear Modulus at very small strains	Clay: Gmax = alpha x Qt	# 8 Fig4.18	Clay	1 to 6
	Sand: Digitized figure of Qc vs Gmax with interpolation between sv' curves, R&C method	# 6 # 8 Fig4.13	Sand	(6 possible) 7 to 10 .25<sv'<8bar
CSR(Qc), t/s LEVEL ground Liquefaction SAND Resistance see NOTE #8	Seed's CSR vs N1(60) graph for specified equake Magnitude. Can include silty sand corr. for Zone 7. N1(60) from CPT correlations.	# 11 # 12	Sand	7 to 10 (6 possible)
CSR(Eq), t/s Cyclic Stress Ratio applied by design quake	$CSR(Eq) = 0.65 \frac{Amax}{g} \frac{sv}{svo'} rd$ Amax=max surface acceleratn including Amplification	# 12 # 3	Sand	7 to 10 (6 possible)
[Note: Input value from input file is used if defined, & not calculated]				
rd Reduction Factor to find CSR(Eq)	Digitized graph to use for depth vs rd: 1) Seed's mean 2) Fraser Delta	# 12 # 3	Sand	(6 possible) 7 to 10 0<depth<30m
FL, Safety Factor against Liquefaction	FL = CSR(Qc)/CSR(Eq)	# 3	Sand	7 to 10 (6 possible)
Qcr Critical Bearng required to resist Liquefctn	Qcr backcalculated from CSR(Eq) for a specified FL. Qcr is only for the given GWT, EOS, OS, Amax/g & Eq.Mag	# 12	Sand	7 to 10 (6 possible)
Su, Undrained Shear Strength of CLAY METHODS:	Nk: $Su = \frac{Qc - st}{Nk}$	# 8	Clay	1 to 6
	Nke: $Su = \frac{Qt - U2}{Nke}$		Clay	1 to 6
	Nkt: $Su = \frac{Qt - sv}{Nkt}$		Clay	1 to 6
	Nc: $Su = \frac{Qt}{Nc}$		Clay	1 to 6
see NOTE #9	NdU: $Su = \frac{dU2}{NdU}$ (dU1 or dU3)		Clay	1 to 6

Parameter	Methods	Refer. Number	Valid Soil Type	Valid Zone
Su/EOS	$Su/EOS = \frac{Su}{sv'}$	# 8	Clay	1 to 6
Ko (NC) Normally Consolidated	$(Ko)NC = 1 - Sin(f)$ see NOTE #10	# 8	Sand	7 to 10 (6 possible)
Ko (OC) Over Consolidated	$(Ko)OC = (Ko)NC \times OCR^{0.42}$	# 8	Sand	7 to 10 (6 possible)
E25 Youngs Modulus	E25 = alpha x Qt where user input alpha	# 8 4.11&12	Sand	(6) 7 to 10 0<Qt<500bar
M Constrained Modulus	CLAY: M = alpha x Qt where user input alpha SAND: Methods: Qt: M = alpha x Qt Baldi: $\frac{M}{Qt} = C0 \times pa \left(\frac{sv'}{pa}\right)^{C1} \times OCR^{C2} \times \exp(C3\ Dr)$	# 8 Tabl4.3 # 8 Fig4.10	Clay Sand Sand	1 to 6 7 to 10 (6 possible) 7 to 10
OCR (Clay) Over- Consolidation Ratio see NOTE #11	$OCR = \left[\frac{\frac{Su}{svo'}}{\left(\frac{Su}{svo'}\right)_{NC}}\right]^{1.25}$	# 6 # 8 Fig4.19	Clay	1 to 6
Ic Material Index After J&D(1993) see NOTE #18	$Ic = \left[\left(3-\log_{10}(Q(1-Bq))\right)^{2} + \left(1.5+1.3\log_{10} F\right)^{2} \right]^{0.5}$	# 13 # 17	All	All
Spt N(60) Standard Penetration Test (Blows/foot) at 60% Energy After J&D(1993) see NOTE #16	Qc/N = 8.5(1-(Ic/4.75)) where Qc in bars	# 13	All	All

Parameter	Methods	Refer. Number	Valid Soil Type	Valid Zone
State Parameter State, (e-units) Current Void Void Ratio minus Critical Void Ratio	$State = \dfrac{\ln\left\lvert\dfrac{3M + 8.5M/F}{Q(1-Bq)}\right\rvert}{11.9 - 1.33F}$ $M = \dfrac{6 \sin fcv}{3 - \sin fcv}$ fcv = const. vol. Phi angle	# 14	All	All
Fines Content FC(%) Percent less than #200 Sieve After Davies,99	FC(%) = 42.4179(Ic) - 54.8574 FC(%) = 0% if Ic < 1.2933 FC(%) = 100% if Ic > 3.6508	# 15	All	All
OCR (Clay) Overcons. Ratio by Pore Press. U1 & U2 or U1 & U3 see NOTE #17	OCR = 0.5 + 1.50(PPD) PPD = (U1 - U2)/Uo or PPD = (U1 - U3)/Uo and default 0.5 & 1.5 are settable	# 16	Clay	1 to 6

1. Depth averaging may be in 0.5, 1, 2.5 or 5 ft. intervals or 0.1, 0.25, 0.5 or 1.0 m intervals, or no depth averaging if zero is selected. The average is the mean value of the readings in the interval. The depth value is the mid-depth of the averaged interval. It is convenient to start at half the depth averaging interval. For example, if you want "even" depths and the depth averaging is set at 0.50 m then start at 0.25 to get values of depth of 0.5, 1.0, 1.5, etc.

2. Basic input CPTU data columns are for Depth, Qc, Fs, U1, U2, U3, INC and TEMP may be selected. In addition the following parameters may also be specified as an INPUT data column: Qt, Gamma, Uo, Spt N, Rf Zone, Bq Zone and CSR(EQ). These values will be used where required to obtain other interpreted parameters. If they are not specified the program will estimate them when they are required. For example, you can create an OUTPUT data file of any of the above parameters and then edit some or all of the values to suite your measurements or your desires to specify their values. You can do that with "Gamma" values to input your measurements of unit weight, or with "Uo" if you want to input values of pore water pressure other than hydrostatic, or with any of the other input parameters. You would use your edited file of adjusted data as your new INPUT data file. Thus, you can specify these parameters if you want to override the Program's values.

You can also use the designated value of "9E9" to denote an unknown value.

You can use the "OTHER" designation to input other data that exists on your input file and identify its units. This allows you to output it, without operating on it, if you choose.

It is best NOT to use depth averaging when using input data that is not continuous at regular depth intervals. Always use DEPTH AVERAGING with extreme caution since the program averages ALL INPUT parameters over the interval chosen irregardless of soil type. Careful use of start and end depth choises can make depth averaging very effective.

3. Since there is no data in the file within the initial depth interval, a default Gamma (unit weight) must be specified from the surface to the starting depth. This is done in the "Param" Menu in units of kN/m^3 (1kN/m^3=6.36pcf). Also, you can specify the values of Gamma to be used by the program as in NOTE #2 above.

4. If pore pressures are not measured by the cone then the program will take Qc as being equal to Qt for all interpretations requiring Qt. Also, Uo may be specified in the input file as a column of Uo vs depth values, if the water pressures are not hydrostatic. See NOTE #2 for more info on customizing input data.

5. You can choose to use either the Rf classif. Zone or the Bq classif. Zone to divide soil into Undrained Parameters (Zones 1 to 6) and Drained Parameters (Zones 7 to 10) in the "Param" Menu. (However, in order to use the Bq Zone you must have Pore Pressure, U2, data.) Also, you may choose to switch Zone 6 to a Drained Zone from its Undrained Zone status. This is done if you feel that the soil identified as Zone 6 (sandy silt) is really coaser (using other sources of information) and/or you want it analyzed as a Drained rather than Undrained soil. Finally, the soil behavior names in each zone were shortened in version 5.0 for simplicity. For example, Zone 6 was named "sandy silt to clayey silt" but was shortened to "sandy silt".

6. Spt N is the same as Spt N(60) for 60% transferred energy. This value is calculated from the Qt/N ratios given for each Soil Zone (you can specify either Rf or Bq Zone) and these values are used in the Level Ground Liquefaction analysis. Values of Spt N may be specified in the Input File, if indepedently measured values are to be used. We suggest that you not use depth averaging if you only have selected Spt N values at a few depths. You may use "9E9" for missing data.

7. If Dr values are negative then soil is very loose or likely more of an undrained soil like a silty sand rather than a drained soil for which the Dr correlations were developed. Use Dr interpretations very cautiously since they also assume the soil is free draining, uncemented, unaged and has the same compressibility of grains as the soil used for the correlations in chamber calibration tests.

8. The simplified sand liquefaction analysis for level ground according to Seed et al requires Spt N1(60) and earthquake magnitude to obtain the cyclic stress ratio to cause liquefaction, CSR(Qc). The design maximum ground acceleration, the depth-reduction factor, Rd, and overburden total and effective stresses are required to calculate the cyclic stress ratio applied by the design earthquake, CSR(EQ). The program estimates the N1(60) values from the cone stresses, the operator identifies the earthquake magnitude and Seed et al chart is used to get CSR(Qc). The program also calculates CSR(EQ) from the user specified maximum ground acceleration including any amplification factors, the calculated overburden stresses and either Seed's mean or the Fraser Delta Rd factor. The Fraser Delta is used only when amplification factors of the order of 2 or more are used. See Reference Nos. 3, 6, 11 and 12 for more information. The user can INPUT specific values for Spt N, CSR(EQ), Soil Zones, Gamma's, etc. in order to customize the analysis for the existing data base of information. It is recommended that you do not use depth averaging when using specific input data but make calculations at specific depths where external input data exists. The calculated value of Qcr is the minimum value of cone bearing stress required at a given depth such that the factor of safety against liquefaction, or the ratio FL = CSR(Qc)/CSR(EQ) have the specified value for a given earthquake magnitude, max. ground acceleration, depth reduction factor, and calculated overburden stresses. This value of Qcr is useful to identify the required minimum level of soil improvement for a given design condition.

9. The NdU method to calculate undrained shear strength has been extended to allow the user to choose either dU1, or dU2 or dU3 provided such pore pressure measurements exist.

10. The Overconsolidation Ratio, OCR, for the sand must be estimated by the user in the "Param" menu if you want to estimate Ko in the sand layers. For the typical normally consolidated sand, OCR = 1.0.

11. It is currently only possible to estimate the OCR for a clay, which makes use of the correlations obtained from extensive laboratory tests.

12. An improved calculation and print routine was added to version 5.0 which uses swap routines to reduce memory requirements, but slows down the calculations.

13. The classification charts for Rf has been extended at all boundaries such that values of Rf>8 and values of Qc<1.00 are possible. The Bq classification chart which requires dU2 and can now accept values of Bq>1.2 and Qt<1. Unfortunately, this feature does not work.

14. Version 5.1ppd added several enhancements to the program. You may input an average vertical flow gradient, which is applied over the entire profile depth to be analysed so adjust the depth of interest accordingly. Zero gives hydrostatic and no flow, a negative gradient is upward flow which increases pore pressure and reduces vertical effective stress. A positive gradient gives downward flow.

15. A State Parameter or current void ratio minus critical void ratio is calculated according to the paper by Ref. 14, Plewes, Davies and Jefferies, 1994.

16. An alternate method to estimate SPT from CPT is provided according to Ref. 13, Jefferies and Davies, 1993 in ASTM.

17. An alternate method to estimate OCR in clays is provided which uses the measured pore pressure difference, ppd, so both U1 and U2 or U1 and U3 must be measured at the same time. (see Ref. 16)

18. Version 5.2 added the value Ic (Material Index) according to Jefferies & Davies, 1993, 1991 (Ref. 13 & 17) which combines all Normalized parameters Q, F and Bq.
(Note: QtN was changed to Q and RfN to F.)

18A. In Version 5.2, if at any depth the value of Bq>1 (in very sensitive saturated soil)then Bq is made equal to 0.99. Also, if Rf>8 it is made 7.99. These changes have a negligable effect on the results.

19. FC(%) or percent of dry weight less than #200 sieve (.074mm) was also added according to Davies, 1999 Ref.#15)

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RFC'D DEC 1 4 2009

BSK

808 East Douglas Avenue
Visalia, CA 93292
(559) 732-8857
(559) 732-6570 FAX

November 21, 2005

BSK Job G05-392-11F
Report No. 1

Mr. Matt Willbanks, P.E.
Quad Knopf, Inc.
5110 W. Cypress Avenue
Visalia, California 93291

SUBJECT: Field Density Testing
Arsenic Removal – Corcoran Water Treatment Plant
Orange Avenue (East of 5th Avenue)
Corcoran, California

Dear Mr. Willbanks:

At your request, BSK and Associates (BSK) performed field density testing of the subject project between October 10, 2005 and November 14, 2005. Field Density test results are tabulated on the enclosed Field Density Report. Test locations are given by reference point and shown on the enclosed Compaction Test Location Map. Test elevations are given with reference to grades existing at the time of testing. Field density test results only were provided by BSK. No field observation was provided by BSK.

The status of the test results are noted on the enclosed summary of field density test results for the subject time period. Relative density for this project is based upon maximum density as determined by ASTM D1557-91.

We appreciate being of service to you on this project. Please call if you have any questions.

Respectfully submitted,
BSK Associates

REGISTERED PROFESSIONAL ENGINEER
JOSUE A. MONTES, JR.
No. C52610
Exp. 12-31-06
CIVIL
STATE OF CALIFORNIA

Josué A. Montes, Jr., P.E.
Manager - Visalia

/JM/dd

Enclosures:

- Summary of Field Density Test Results
- Summary of Laboratory Maximum Density Test Results
- Figure 1: Compaction Test Location Map

Distribution:

- Client
- Mr. Steve Kroeker, City of Corcoran
- BSK File

SUMMARY OF LABORATORY RESULTS
MAXIMUM DENSITY AND OPTIMUM MOISTURE
ASTM D1557-91

Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 lbs-ft/ft^3)

Sample No. 1:

Maximum Density: 118.7 pcf
Optimum Moisture Content: 11.7 %

Soil Description: Olive Brown; sandy silt, fine grain, mica and non-cohesive.
Sample Location: Stockpile East of North End of 5th (Import)
Sample Date: 10/10/2005

Sample No. 2:

Maximum Density: 109.0 pcf
Optimum Moisture Content: 16.5 %

Soil Description: Sandy Silt; clayey silt, olive brown, fine to med. grain, some mica.
Sample Location: Near BW Reclaim Tank; Near Stake #1026 (Native)
Sample Date: 10/11/2005

Sample No. 3:

Maximum Density: 123.5 pcf
Optimum Moisture Content: 11.0 %

Soil Description: Silty Sand; low silt, dark brown, fine to med. grain, some mica.
Sample Location: Near Finish Water Reservoir; Near Stake #1000 (Native)
Sample Date: 10/11/2005

Sample No. 4:

Maximum Density: 119.0 pcf
Optimum Moisture Content: 11.2 %

Soil Description: Olive green; silty sand with clay.
Sample Location: Sump Area (Native)
Sample Date: 10/12/2005

Sample No. 5:

Maximum Density: 119.5 pcf
Optimum Moisture Content: 12.5 %

Soil Description: Clayey Sand; grayish brown, fine to med. grain, micaceous.
Sample Location: Near Stake #1033; -1.0 to 0.0 (Native)
Sample Date: 10/25/2005

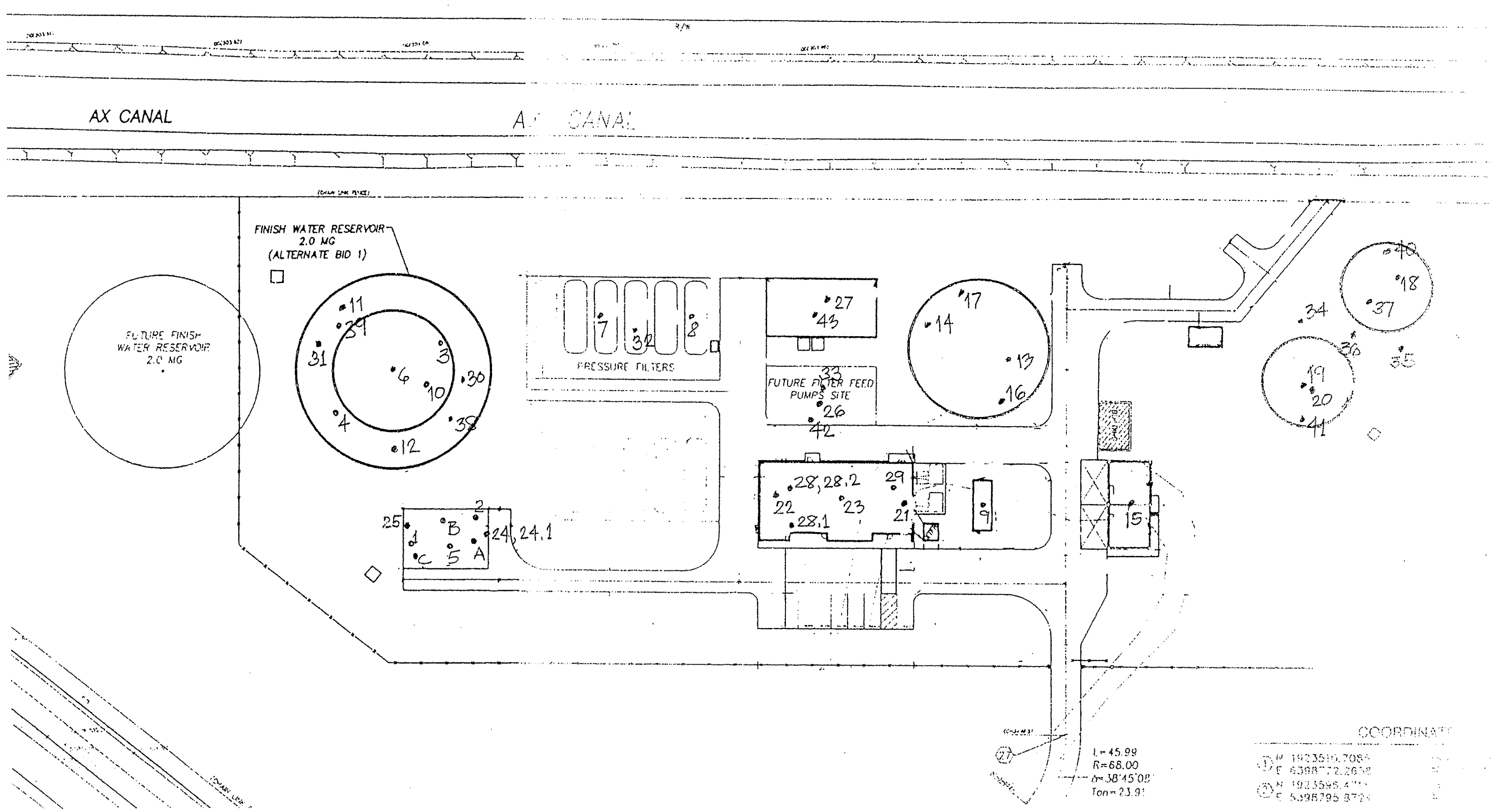
SUMMARY OF FIELD DENSITY TEST RESULTS

Seq. Test/ Retest No.	Date	Tech	Location	Elev./ Depth	Moist. (%)	Dry Density (pcf)	Sample No.	Compaction (%)	Req'd Compaction (%)	Pass/ Fail
A	10-14-05	CH	Station #3 Pump Pad	-7.0'	13.7	107.2	3	87	90	F
B	10-14-05	CH	Station #3 Pump Pad	-7.0'	15.3	109.5	3	89	90	F
C	10-14-05	CH	Station #3 Pump Pad	-7.0'	16.2	105.8	3	86	90	F
1	10-17-05	CH	Station #3 Pump Pad; SW Quad	-3.0'	11.3	111.3	3	90	90	P
2	10-17-05	CH	Station #3 Pump Pad; NE Quad	-3.0'	12.1	112.7	3	91	90	P
3	10-17-05	CH	Finish Water Reservoir; NE Quad	-3.0'	6.0	117.3	3	95	90	P
4	10-17-05	CH	Finish Water Reservoir; SW Quad	-3.0'	6.6	116.0	3	94	90	P
5	10-17-05	CH	Station #3 Pump Pad; Center	-5.0'	12.8	112.4	3	91	90	P
6	10-18-05	CH	Finish Water Reservoir; Center	-2.0'	10.8	112.0	3	90	90	P
7	10-18-05	CH	Pressure Filter Pad; West Half	-4.0'	15.6	101.4	2	93	90	P
8	10-18-05	CH	Pressure Filter Pad; East Half	-4.0'	14.2	105.7	2	97	90	P
9	10-18-05	CH	Generator Pad; Center	-2.0'	14.5	114.6	3	93	90	P
10	10-19-05	CH	Finish Water Reservoir; East Center	0.0'	15.8	101.4	2	93	90	P
11	10-19-05	CH	Finish Water Reservoir; North West	0.0'	15.6	100.7	2	92	90	P
12	10-19-05	CH	Finish Water Reservoir; South Center	0.0'	17.2	104.6	2	96	90	P
13	10-20-05	CH	Raw Water Storage Tank; Center	-9.0'	17.0	107.1	2	98	90	P
14	10-20-05	CH	Raw Water Storage Tank; West End	-5.0'	16.0	101.4	2	93	90	P
15	10-20-05	CH	Chemical Storage; Center	-2.0'	17.4	103.1	2	95	90	P
16	10-21-05	CH	Raw Water Storage Tank; S/E End	RFSG	13.3	111.0	3	90	90	P
17	10-21-05	CH	Raw Water Storage Tank; North End	RFSG	16.4	106.3	2	97	90	P
18	10-21-05	CH	Backwash Tanks; North End	-3.0'	19.4	99.6	2	91	90	P
19	10-21-05	CH	Backwash Tanks; South End	0.0'	21.4	99.5	2	91	90	P
20	10-24-05	CH	Backwash Tanks; Center	0.0'	18.1	97.6	2	90	90	P
21	10-24-05	CH	Operations Building; East End	RFSG	14.1	107.5	2	99	90	P
22	10-24-05	CH	Operations Building; West End	RFSG	14.1	105.1	2	96	90	P
23	10-24-05	CH	Operations Building; Center	-2.0'	16.6	104.9	2	96	90	P
24	10-25-05	CH	Station #3 Pad- Select Fill; East End	0.0'	14.7	94.6	2	87	90	F
25	10-25-05	CH	Station #3 Pad- Select Fill; West End	0.0'	11.6	100.0	2	92	90	P

Seq. Test/ Retest No.	Date	Tech	Location	Elev./ Depth	Moist. (%)	Dry Density (pcf)	Sample No.	Compaction (%)	Req'd Compaction (%)	Pass/ Fail
26	10-25-05	CH	Filter Pump Pad; South End	-2.0'	14.7	103.4	2	95	90	P
27	10-25-05	CH	Filter Pump Pad; North End	-2.0'	17.2	101.0	2	93	90	P
28	10-25-05	CH	Operations Bldg.- Select Fill; West End	-1.0'	14.0	94.0	5	79	90	F
RT-1 28.1	10-27-05	JM	Operations Bldg.- Select Fill; West End	-1.0'	16.7	114.0	5	95	90	P
RT-2 28.2	10-28-05	CH	Operations Bldg.- Select Fill; West End	-1.0'	10.6	111.0	5	93	90	P
29	10-28-05	CH	Operations Bldg.- Select Fill; East End	0.0'	11.4	109.7	5	92	90	P
30	10-28-05	CH	Finish Water Reservoir; East End	-2.5'	10.8	114.2	3	92	90	P
31	10-28-05	CH	Finish Water Reservoir; West End	-1.0'	10.1	115.1	3	93	90	P
RT-1 24.1	10-28-05	CH	Station #3 Pad- Select Fill; East End	0.0'	13.9	101.0	2	92	90	P
32	10-28-05	CH	Pressure Filter Pad; Center	0.0'	14.0	102.4	2	94	90	P
33	10-28-05	CH	Filter Pump Pad; Center	-1.0'	14.4	104.2	2	96	90	P
34	10-28-05	CH	Backwash Tanks; West End	-2.0'	10.4	104.0	2	95	90	P
35	10-28-05	CH	Backwash Tanks; East End	-2.0'	11.2	103.3	2	95	90	P
36	10-28-05	CH	Backwash Tanks; Center	0.0'	10.7	104.4	2	96	90	P
37	10-28-05	CH	BWR Pumps Pad; Center	-3.5'	9.5	108.7	5	91	90	P
38	11-01-05	CH	Finish Water Reservoir-Select Fill; SE Quad	0.0'	10.4	114.3	1	96	90	P
39	11-01-05	CH	Finish Water Reservoir-Select Fill; NW Quad	0.0'	12.8	108.3	1	91	90	P
40	11-03-05	CH	Backwash Tanks-Select Fill; North End	0.0'	13.7	114.7	1	97	90	P
41	11-03-05	CH	Backwash Tanks-Select Fill; South End	0.0'	11.8	116.7	1	98	90	P
42	11-03-05	CH	Filter Feed Pump-Select Fill; South End	0.0'	15.0	113.9	1	96	90	P
43	11-03-05	CH	Filter Feed Pump-Select Fill; North End	0.0'	14.6	112.4	1	95	90	P
44	11-11-05	CH	6" Sewer w/of Operations Building	-4.0'	10.5	105.6	2	96	90	P
45	11-11-05	CH	6" Sewer w/of Operations Building	0.0'	10.9	106.5	2	97	90	P
			--- END ---							

NOTES: **Elevation 0.0' = Existing grade at time of start of grading.**
RFSG = Rough Finished Subgrade.
Tests A, B, and C were indicator tests only.

BSK G05-395-11F
FIGURE 1
COMPACTION TEST LOCATION MAP



Legend: •12 - Approximate Location of Density Test

ARSENIC REMOVAL CORCORAN WATER TREATMENT PLANT
ORANGE AVENUE
CORCORAN, CA

Reference: Drawings by Quad Knopf

BSK

BSK Associates
An Employee Owned Company

REC'D DEC 14 2009

October 16, 2006

BSK Job G05-392-11F
Report No. 4

Steve Kroeker, Public Works Director
City of Corcoran
1033 Chittenden Ave.
Corcoran, California 93212

SUBJECT: **Compaction Testing**
Arsenic Removal-Water Treatment Plant
Orange Avenue (E. of 5th)
Corcoran, California

Dear Mr. Kroeker:

BSK has performed field density testing at the subject project on June 30, 2006. Field Density test results are tabulated on the enclosed Field Density Report Summary. Test locations are given by reference point and shown on the enclosed Compaction Test Location Sketches.

The status of the test results are noted on the enclosed summary of field density test results for the subject time period. Relative compaction for this project is based upon maximum density as determined by ASTM D1557-91. All tests up to the listed depths met or exceeded the minimum compaction requirements.

We appreciate being of service to you on this project. Please call if you have any questions.

Respectfully submitted,
BSK Associates

Ryan K Privett

Ryan K. Privett, P.E.
Senior Engineer

REGISTERED PROFESSIONAL ENGINEER
RYAN K. PRIVETT
No. C59372
Exp. 9-30-07
CIVIL
STATE OF CALIFORNIA

RKP/ym

Enclosures:
- Summary of Field Density Test Results
- Summary of Laboratory Maximum Density Test Results
- Compaction Test Location Sketches

Distribution:
- Client (2 Originals)
- Quad Knopf, Attn: Matt Willbanks, P.E.
- BSK File

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BSK ASSOCIATES

FIELD DENSITY REPORT SUMMARY

Project: Arsenic Removal - Water Treatment Plant

Test/Retest Sequence	Date Tested	Tech.	Location	Depth	IN-PLACE Moisture	IN-PLACE Dry Density	LABORATORY Sample No.	LABORATORY Optimum Moisture	LABORATORY Maximum Density	Relative Compaction	Required Compaction	Pass/ Fail
Number				(ft.)	(%)	(pcf)		(%)	(pcf)	(%)	(%)	
114 R 1	6/30/06	LH	Entrance Rd., AB, see sketch	0	6.8	144.9	7	5.5	149.5	97	95	P
115 R 1	6/30/06	LH	Entrance Rd., AB, see sketch	0	7.0	145.3	7	5.5	149.5	97	95	P
116 R 1	6/30/06	LH	Entrance Rd., AB, see sketch	0	6.5	144.4	7	5.5	149.5	97	95	P
117 R 1	6/30/06	LH	Parking Lot @ Ops Bldg, AB, see sketch	0	6.9	143.9	7	5.5	149.5	96	95	P
118	6/30/06	LH	Access Rd SW of Future Press. Filters, AB, see sketch	0	8.5	144.1	7	5.5	149.5	96	95	P
119	6/30/06	LH	Access Rd S of Future Press. Filters, AB, see sketch	0	6.3	141.9	7	5.5	149.5	95	95	P
120	6/30/06	LH	Access Rd E of Future Press. Filters, AB, see sketch	0	7.5	146.4	7	5.5	149.5	98	95	P
121	6/30/06	LH	Access Rd N of Future Press. Filters, AB, see sketch	0	5.9	142.4	7	5.5	149.5	95	95	P
122	6/30/06	LH	Access Rd N of Ops Bldg, AB, see sketch	0	6.1	143.2	7	5.5	149.5	96	95	P
123	6/30/06	LH	Entrance Rd., AB, see sketch	0	7.2	145.9	7	5.5	149.5	98	95	P

FIELD DENSITY REPORT SUMMARY

Project: Arsenic Removal - Water Treatment Plant

Test/Retest Sequence	Date Tested	Tech.	Location	Depth	IN-PLACE Moisture	IN-PLACE Dry Density	LABORATORY Sample No.	LABORATORY Optimum Moisture	LABORATORY Maximum Density	Relative Compaction	Required Compaction	Pass/ Fail
Number				(ft.)	(%)	(pcf)		(%)	(pcf)	(%)	(%)	
124	6/30/06	LH	Entrance Rd., AB, see sketch	0	6.6	143.8	7	5.5	149.5	96	95	P
125	6/30/06	LH	Entrance Rd., AB, see sketch	0	6.9	145.7	7	5.5	149.5	97	95	P
126	6/30/06	LH	Parking Lot @ Ops Bldg, AB, see sketch	0	6.1	143.2	7	5.5	149.5	96	95	P

SUMMARY OF LABORATORY RESULTS
MAXIMUM DENSITY AND OPTIMUM MOISTURE
ASTM D1557-91
Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 lbs-ft/ft^3)

Sample No. 1:

Maximum Density:	118.7 pcf
Optimum Moisture Content:	11.7 %
Soil Description:	Olive brown, sandy silt, fine grain, mica and non-cohesive.
Sample Location:	Stockpile east of North end of 5th (import)
Sample Date:	10/10/2005

Sample No. 2:

Maximum Density:	109.0 pcf
Optimum Moisture Content:	16.5 %
Soil Description:	Sandy silt, clayey silt, olive brown, fine to medium grain, some mica
Sample Location:	Near BW reclaim tank, near Stake # 1026 (native)
Sample Date:	10/11/2005

Sample No. 3:

Maximum Density:	123.5 pcf
Optimum Moisture Content:	11.0 %
Soil Description:	Silty sand, low silt, dark brown, fine to medium grain, some mica.
Sample Location:	Near finish water reservoir, near stake # 1000 (native).
Sample Date:	10/11/2005

Sample No. 4:

Maximum Density:	113 pcf
Optimum Moisture Content:	15.0%
Soil Description:	Sandy clay, dark olive brown, fine to medium grain, micaceous.
Sample Location:	(native)
Sample Date:	10/25/2005

Sample No. 5:

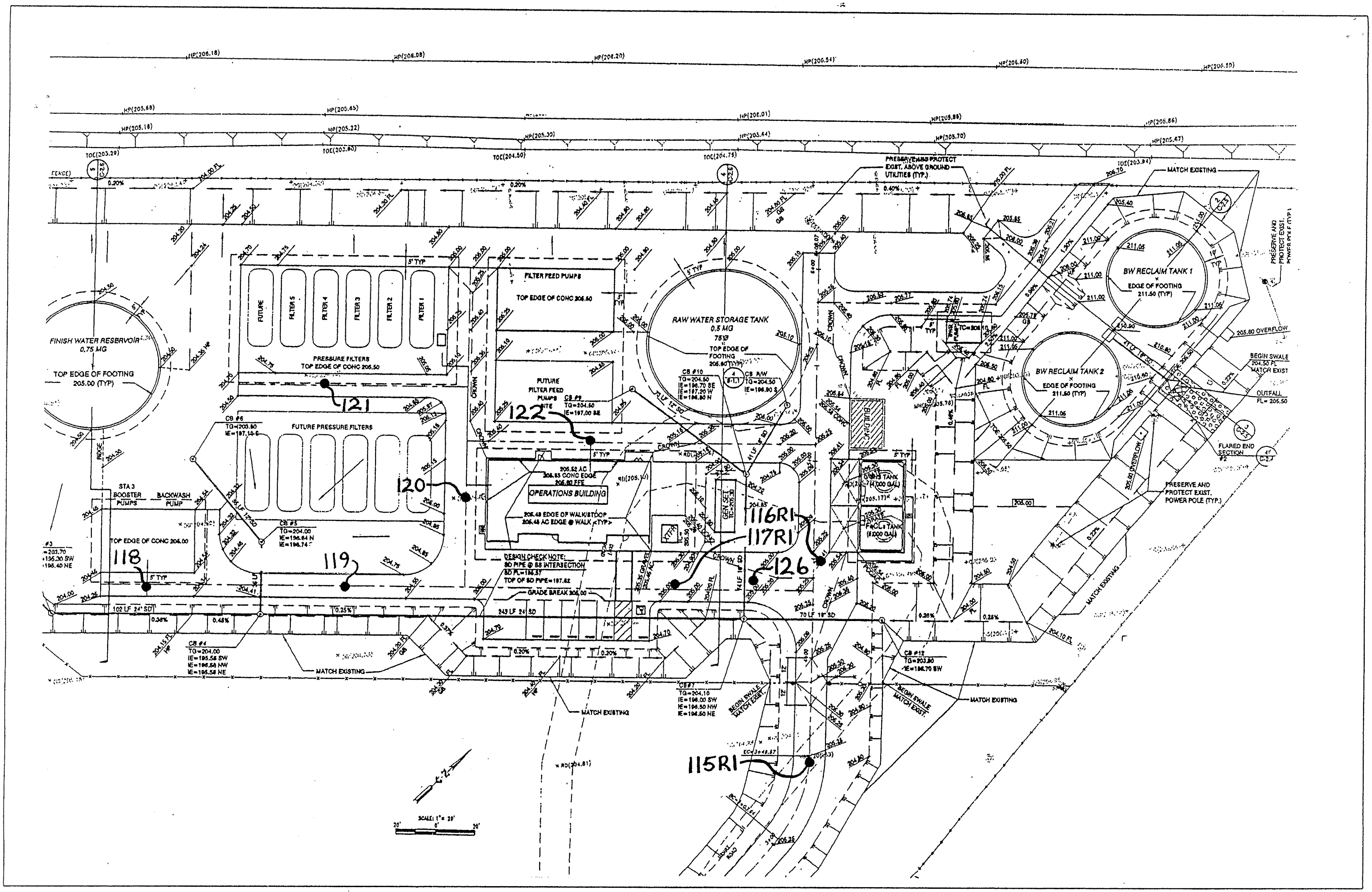
Maximum Density:	119.5 pcf
Optimum Moisture Content:	12.5%
Soil Description:	Clayey sand, grayish brown, fine to medium grain, micaceous
Sample Location:	Near stake #1033, -1.0 to 0.0 (native)
Sample Date:	10/25/2005 check point on 12/15/2005

Sample No. 6:

Maximum Density:	146.9 pcf
Optimum Moisture Content:	12.5 %
Soil Description:	Aggregate base
Sample Location:	On-site stockpile
Sample Date:	11/21/2005

Sample No. 7:

Maximum Density:	149.5 pcf
Optimum Moisture Content:	5.5 %
Soil Description:	Aggregate base
Sample Location:	Composite, from grade
Sample Date:	06/26/2006



● = APPROXIMATE LOCATION OF COMPACTION TEST

COMPACTION TEST LOCATION MAP

Arsenic Removal WTP

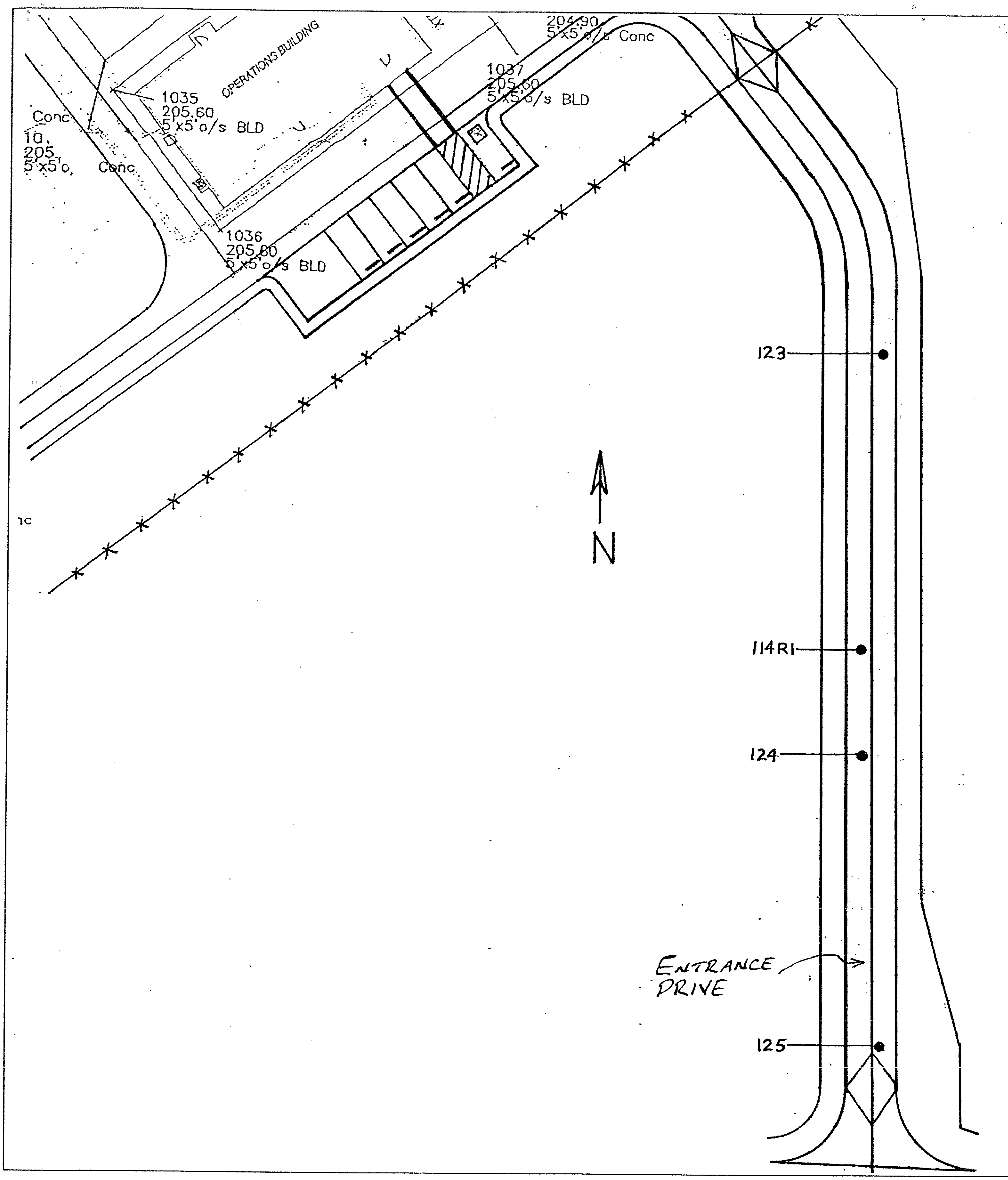
MAIN PLANT AREA
CORCORAN, CALIFORNIA

BSK

G05-392-11F

10/24/2006

FIGURE 1



NO SCALE

1 ● = APPROXIMATE LOCATION OF COMPACTION TEST

BSK

COMPACTION TEST LOCATION MAP

Arsenic Removal WTP

ENTRANCE DRIVE

CORCORAN, CALIFORNIA

G05-392-11F 10/24/2006 FIGURE 2